DRILLING WATER QUALITY

During the drilling program, samples of ground water are taken from specified intervals for analysis. A summary of the resulting water quality data is presented in the following Tables II B-5 through II B-14.

The data are presented for the depth at which the drilling bit was located when the water sample was taken. Since the sample was taken from the drilling water flow line, the data presented reflect composite conditions throughout the hole from the surface to sample depth.

All samples were analyzed for major and minor constituents, trace metals, radioactivity and total organic carbon. Major constituent analysis is regularly prepared by three different laboratories: TOSCO, Industrial Laboratories, and Commercial Testing and Engineering. Minor constituents and metals are analyzed by the latter two laboratories. Trace metal analyses and total organic carbon analyses are prepared by Commercial Testing and Engineering. Radioactivity is analyzed by Hazen Research, Inc.

Since some of the analyses are duplicated on the same sample by two or more laboratories, a comparison of independent analytical results is possible in some cases. All of the lab reports from each laboratory are included here for comparison following Tables II B-5 through II B-14. The single set of results for each element in the summary tables are the result of our critical evaluation of which laboratory used the best analytical methods where two or more labs performed the same analysis. For example, one laboratory's atomic absorption method appears more accurate for the more common metals than another laboratory's spark source method since the spark source method has a tendency to consume the salts so that readings on elements such as Boron would be too low.

SHOUT
SHARE
IT

TABLE ____

WATER QUALITY ANALYSIS

ALLUVIAL WELLS[a]

Location: See Fig. II B-1 (unless stated otherwise, all units are mg/l)

	Element Measured	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
1.	Aluminum	.32	.34	.14		.06	.05	.05	.05	.05	.25	.52	.17	
2.	Ammonia	<.1	.6	.1		.1	.1	.1	0.1	.2	.1	.1	.1	
3.	Arsenic	.005	.01	.004		.05	.004	.02	.004	<.008	.001	.009	.008	
4.	Barium	0.2	0.1	0.2		0.6	.03	0.4	.04	0.2	.05	0.1	.04	
5.	Beryllium	<.001	<.001	.001		<.01	<.003	<.003	<.008	.001	<.001	<.02	<.02	
6.	Bicarbonate	663	586	562		516	670	405	630	450	436	475	585	
7.	Bismuth	<.005	<.003	<.006		<.01	<.003	<.003	<.008	<.002	<.002	<.02	<.0	
8.	Boron	.6	1.7	.7		1.2	1.4	1.4	0.7	0.7	.7	.6	1.2	
9.	Cadmium	.01	.12	.016		<.001	<.003	<.003	<.001	<.002	<.002	<.002	<.002	
10.	Calcium	80	52	58		36	30	16	56	49	69	61	105	
11.	Carbonate	<.1	<.1	<.1		<.1	<.1	18	<.1	0.0	<.1	<.1	<.1	
12.	Cerium	0.02	.01	.02		.007	.01	<.003	.006	.002	.003	.01	<.02	
13.	Chloride	15	10	7.6		15	17	11	3.5	3.5	4.8	4.2	3.5	
14.	Chrome, Hexavalent	<.01	<.01	<.01		<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	
15.	Cobalt	0.02	.05	.02		.04	.004	0.3	.002	.02	.003	.02	.009	
16.	Conductivity, Specific	1790	1240	1480		1480	1540	1180	1400	1080	1270	1480	1510	
17.	Copper	.05	.03	<.1		.1	.09	.04	.07	.01	.03	.2	.03	
18.	Fluoride	3.4	5.0	1.9		1.5	1.9	8.0	.8	.8	.8	.5	.7	
19.	Gallium	<.005	.01	<.006		.03	<.003	.002	.007	.004	<.002	<.02	<.02	
20.	Hardness, Total	530	395	330		352	360	122	386	358	498	502	478	
21.	Hydroxide	<.1	<.1	<.1		<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.1	
22.	Iron	9.4	3.5	.05		.05	.05	.05	.05	.05	.17	1.3	2.8	
23.	Lead	.03	.03	.03		<.001	.01	.05	.07	.05	.05	.2	.05	
24.	Lithium	.4	.3	.5		.5	.5	.5	.5	.5	.3	.5	.5	
25.	Magnesium	80	65	45		64	70	20	60	57	79	85	53	
26.	Manganese	.96	1.5	2.2		2.3	.12	.74	2.1	.70	.92	.52	.09	
27.	Mercury	.0003	.0002	.0003		.0001	.0017	.0002	.0012	.0001	.0001	.0003	.0002	
28.	Molybdenum	.02	.005	.02		.02	<.003	.01	.04	.02	.02	.02	<.02	
29.	Nickel	.05	.05	.07		.09	.02	.02	0.01	.04	.02	0.1	0.02	
30.	Nitrate	.3	.6	3.0		2.2	3.5	4.3	3.5	6.6	9.1	3.1	2.9	
31.	pH	7.8	7.4	7.5		7.8	7.4	8.4	7.6	7.4	8.0	7.4	7.3	
32.	Phosphate, Total	<.1	1.1	.3		0.2	0.3	0.4	.1	.1	.1	.1	.1	
33.	Potassium													
34.	Selenium	<.005	<.003	<.006		.06	<.003	<.003	<.008	<.002	<.002	<.02	<.02	
35.	Silica	17	22	18		17	20	41	16	14	14	14	15	
(*)36.	Silver	<.005	<.003	<.006		<.001	<.003	<.003	<.008	<.002	<.002	<.002	<.002	
37.	Sodium	270	255	250		290	295	375	290	150	160	185	730	
38.	Solids, Dissolved	1330	1110	1050	DRY HOLE	1215	1170	1166	1218	861	1000	1062	1179	
39.	Strontium	1	2	2		4	3	2	3	2	0.7	3	3	DRY HOLE
40.	Sulfate	530	415	400		500	405	475	480	360	450	475	480	
41.	Titanium NO WAY!! →	1	0.4	0.7		1	.08	0.1	.2	0.3	0.1	2	0.4	
42.	Vanadium	.02	.02	.01		.03	.002	.006	.01	.02	.009	0.2	.01	
43.	Yttrium	<.005	.003	.006		.004	.001	.001	<.008	.002	.002	<02	.007	
44.	Zinc	.5	.05	.3		1	.2	.06	.5	.1	.05	0.4	.5	
45.	Zirconium	<.005	<.005	<.006		.01	<.003	<.003	<.008	<.01	.002	<.02	<.02	
46.	Radioactivity													
	Gross Alpha (pcl)	4.3	2.3	0		0	2.9	14	1.5	0	2.3	5.0	1.6	
	Radium 226*	0.2						0.3				0		
	Gross Beta (pcl)	0	0	0		0	0	0	0	0	0	0	0	
	Thorium 230**													
	Uranium**													
47.	Total Organic Carbon (TOC) If TOC > 10 mg/l then measure	7	7	7		7	7	8	8	6	3	3	3	
	Dissolved Organic Carbon													
	Suspended Organic Carbon													
	Phenols													
	Sulfate, Acid Extraction													
	Nitrogen, Base Extraction													

(*) Not required

* Required if gross alpha is greater than 4 picocuries per liter (pcl).

** Required if gross beta is greater than 100 picocuries per liter (pcl).

Datum for alluvial wells: (1) 6200' (2) 6200' (3) 6340' (5) 6257' (6) 6268' (7) 6282' (8) 6330' (9) 6481' (10) 6542'
(Ground Level Elevation) (11) 6436' (12) 6612'

(a) All samples were taken October 9-10, 1974.

TABLE II B-6

WATER QUALITY ANALYSIS
DRILLING WATER

Well Number: AT-1 (Unless otherwise stated, all units are mg/l)
Location: 1417.3'FSL&1588.3'FWL Sec. 7T3SR96W Elevation: 6909 Grd. (ft.)

		Depth at Which Sample Taken (ft.)				
	Element Measured	952				
1.	Aluminum	18				
2.	Ammonia	.39				
3.	Arsenic	.2				
4.	Barium	.04				
5.	Beryllium	<.001				
6.	Bicarbonate	357				
7.	Bismuth	<.001				
8.	Boron	.01				
9.	Cadmium	<.001				
10.	Calcium	32				
11.	Carbonate	7				
12.	Cerium	<.001				
13.	Chloride	0.9				
14.	Chrome, Hexavalent	<.01				
15.	Cobalt	.04				
16.	Conductivity, Specific					
17.	Copper	.1				
18.	Fluoride	2.1				
19.	Gallium	.001				
20.	Hardness, Total	190				
21.	Hydroxide	<.1				
22.	Iron	6				
23.	Lead	<.001				
24.	Lithium	.04				
25.	Magnesium	24				
26.	Manganese	.01				
27.	Mercury	<.01				
28.	Molybdenum	.03				
29.	Nickel	.02				
30.	Nitrate	.21				
31.	pH	8.5				
32.	Phosphate, Total	.05				
33.	Potassium	.6				
34.	Selenium	<.001				
35.	Silica	21				
(*)36.	Silver	<.001				
37.	Sodium	136				
38.	Solids, Dissolved	582				
39.	Strontium	6				
40.	Sulfate	183				
41.	Titanium	0.1				
42.	Vanadium	.01				
43.	Yttrium	<.001				
44.	Zinc	.09				
45.	Zirconium	.001				
46.	Radioactivity					
	Gross Alpha (pcl)	13				
	Radium 226*	2.3				
	Gross Beta (pcl)	8				
	Thorium 230**					
	Uranium**					
47.	Total Organic Carbon (TOC) If TOC > 10 mg/l then measure	7				
	Dissolved Organic Carbon					
	Suspended Organic Carbon					
	Phenols	<.001				
	Sulfate, Acid Extraction					
	Nitrogen, Base Extraction					
48.	Cyanide	<.01				

(*) Not required
* Required if gross alpha is greater than 4 picocuries per liter (pcl).
** Required if gross beta is greater than 100 picocuries per liter (pcl).

TABLE II B-7

WATER QUALITY ANALYSIS
DRILLING WATER

Well Number: AT-1A (Unless otherwise stated, all units are mg/l)
Location: 1369.2'FSL&1512.7'FWL Sec. 7T3SR96W Elevation: 6909 Grd.

		Depth at Which Sample Taken (ft.)				
	Element Measured	960	1344	1424	1620	
1.	Aluminum	0.1	✓	✓	2	
2.	Ammonia	1.9		1.6	2.2	
3.	Arsenic	0.05	<.01	<.01	<.01	
4.	Barium	0.01	<1.0	<1.0	0.06	
5.	Beryllium	<.1	<.1	<.1	<.1	
6.	Bicarbonate	337	570	586	583	
7.	Bismuth	<.001	✓	✓	<.001	
8.	Boron	2.4	0.6	4.1	<0.1	
9.	Cadmium	<.01	<.01	<.01	<.01	
10.	Calcium	11	10	11	10	
11.	Carbonate	4	12	14	14	
12.	Cerium	<.001	✓	✓	<.001	
13.	Chloride	4	3	2.1	2.2	
14.	Chrome, Hexavalent	<.01	<.01	<.01	<.01	
15.	Cobalt	0.007			0.007	
16.	Conductivity, Specific					
17.	Copper	<.1	<.1	<.1	<.1	
18.	Fluoride	.9	14	15	17	
19.	Gallium	0.001	✓	✓	0.002	
20.	Hardness, Total	96	64	64	54	
21.	Hydroxide	<.1	<.1	<.1	<.1	
22.	Iron	<.05	<.05	<.05	<.05	
23.	Lead	.003	<.05	<.05	.003	
24.	Lithium	0.6	<0.5	<0.5	<0.5	
25.	Magnesium	21	6	6	5	
26.	Manganese	0.05	<.05	<.05	<.05	
27.	Mercury	.0005	<.01	<.01		
28.	Molybdenum	0.09	<.1	<.1	.05	
29.	Nickel	0.02	✓	✓	0.02	
30.	Nitrate	0.46	<0.1	<0.1	<0.1	
31.	pH	8.3	8.5	8.5	8.4	
32.	Phosphate, Total	<0.1	0.3	<0.1	<0.1	
33.	Potassium	0.3	0.5	0.5	0.5	
34.	Selenium	0.002	<.01	<.01	<.01	
35.	Silica	24	13	13	13	
(*)36.	Silver	.001	.01	.01	.01	
37.	Sodium	156	248	250	246	
38.	Solids, Dissolved	581	633	638	617	
39.	Strontium	1	✓	✓	0.7	
40.	Sulfate	195	47	39	24	
41.	Titanium	0.01	✓	✓	0.07	
42.	Vanadium	0.003	✓	✓	0.001	
43.	Yttrium	<.001	✓	✓	<.001	
44.	Zinc	.03	<.5	<.5	.09	
45.	Zirconium	<.001	✓	✓	<.001	
46.	Radioactivity Gross Alpha (pcl)	✓	✓	✓	5.9	
	Radium 226*				0.3	
	Gross Beta (pcl)	✓	✓	✓	7.0	
	Thorium 230**					
	Uranium**					
47.	Total Organic Carbon (TOC)				8	
	If TOC > 10 mg/l then measure Dissolved Organic Carbon					
	Suspended Organic Carbon					
	Phenols	<.003	<.001	<.001	<.001	
	Sulfate, Acid Extraction					
	Nitrogen, Base Extraction					

(*) Not required
* Required if gross alpha is greater than 4 picocuries per liter (pcl).
** Required if gross beta is greater than 100 picocuries per liter (pcl).

✓ insufficient sample to determine

TABLE II B-8

WATER QUALITY ANALYSIS
DRILLING WATER

Well Number: AT-1C (Unless otherwise stated, all units are mg/l)
Location: 1477.1'FSL&1660.1'FWL Sec. 7T3SR96W Elevation: 6905 Grd.

		Depth at Which Sample Taken(ft.)				
	Element Measured	1	2	3	4	
1.	Aluminum	0.4	10	2	0.3	
2.	Ammonia			1.4		
3.	Arsenic	<.009	.02	<.004	0.006	
4.	Barium	0.01	0.09	0.06	0.04	
5.	Beryllium	0.001	<.009	<.004	<.002	
6.	Bicarbonate	520	705	729	744	
7.	Bismuth	<.009	<.009	<.004	<.002	
8.	Boron	1.3	0.35	0.25	0.008	
9.	Cadmium	<.009	<.01	<.01	<.002	
10.	Calcium	67	4.0	3.6	2.4	
11.	Carbonate	<0.1	24	36	27	
12.	Cerium	<.009	0.005	0.003	0.002	
13.	Chloride	8	4	1	2	
14.	Chrome, Hexavalent	<.01	<.01	<.01		
15.	Cobalt	0.004	0.004	0.01	<.002	
16.	Conductivity, Specific					
17.	Copper	0.05	0.04	<.1	0.03	
18.	Fluoride	1.9	20	21	22	
19.	Gallium	<.009	0.006	<.004	<.002	
20.	Hardness, Total	350	60	40		
21.	Hydroxide	<.1	<.1	<.1		
22.	Iron	<.05	<.05	<.05	0.5	
23.	Lead	0.5	0.8	<.05	0.1	
24.	Lithium	.2	.4	.07	0.04	
25.	Magnesium	41	2.4	2.2	2.0	
26.	Manganese	0.26	0.07	<.05	0.01	
27.	Mercury	<.01	<.01	<.01	<.01	
28.	Molybdenum	0.02	0.03	0.01	0.009	
29.	Nickel	0.01	0.008	0.004	0.002	
30.	Nitrate	<.1	<.1	0.2		
31.	pH	8.2	8.7	8.8	8.6	
32.	Phosphate, Total	<.1	<.1	<.1		
33.	Potassium	2	1.3	0.6	0.7	
34.	Selenium	<.01	<.01	<.01	<.002	
35.	Silica	16	15	13	14	
(*)36.	Silver	.009	0.014	.004	.002	
37.	Sodium	240	324	330	318	
38.	Solids, Dissolved	1020	743	765	755	
39.	Strontium	4	0.3	0.4	0.1	
40.	Sulfate	389	2.5	<2	2.5	
41.	Titanium	0.3	0.06	0.05	0.01	
42.	Vanadium	<.009	0.003	<.001	<.001	
43.	Yttrium	<.009	<.009	<.004	<.002	
44.	Zinc	0.8	0.2	3.0	0.6	
45.	Zirconium	<.009	<.009	<.004	<.002	
46.	Radioactivity					
	Gross Alpha (pcl)	24	8.6	4.7	3.6	
	Radium 226*	0	0.7	0.2	0.1	
	Gross Beta (pcl)	4	0	9	14	
	Thorium 230**					
	Uranium**					
47.	Total Organic Carbon (TOC)	<.1	<.1	<.1	<.1	
	If TOC > 10 mg/l then measure					
	Dissolved Organic Carbon					
	Suspended Organic Carbon					
	Phenols	<.001	<.001	<.001		
	Sulfate, Acid Extraction					
	Nitrogen, Base Extraction					

(*) Not required
* Required if gross alpha is greater than 4 picocuries per liter (pcl).
** Required if gross beta is greater than 100 picocuries per liter (pcl).

(1) 1362'-1512'
(2) 1515'-1640'
(3) 1566'-1640' (Jetting Test sample)
(4) 1566'-1640' (Drilling sample)

TABLE II B-9

WATER QUALITY ANALYSIS
DRILLING WATER

Well Number: SG-6 (Unless otherwise stated, all units are mg/l)
Location: 2523.0'FSL&2251.3'FWL Sec.7T3SR96W Elevation: 6888

		Depth at Which Sample Taken (ft.)				
	Element Measured	910	1350	1425	1547	2220
1.	Aluminum		0.3	0.3	0.2	
2.	Ammonia		.3	<.1	0.3	0.8
3.	Arsenic	<.01	.01	.01	.03	<.01
4.	Barium	<1.0	.03	.03	.08	<1
5.	Beryllium		<.002	<.002	<.004	
6.	Bicarbonate	360	739	751	769	760
7.	Bismuth		<.002	<.002	<.004	
8.	Boron	2.5	1.2	1.2	<.5	<.1
9.	Cadmium	<.01	<.002	<.002	<.004	<.01
10.	Calcium	25	8	5.1	4.3	7.4
11.	Carbonate	30	24	25	23	48
12.	Cerium		<.002	<.002	.003	
13.	Chloride	19	5	2	3	13
14.	Chrome, Hexavalent	<.01	<.01	<.01	<.01	<.01
15.	Cobalt	<.1	.003	.003	.003	
16.	Conductivity, Specific					
17.	Copper	<.1	.01	.02	.03	<.1
18.	Fluoride	4.2	13	19	19	4.5
19.	Gallium		<.002	<.002	<.004	
20.	Hardness, Total	140	60	36	30	44
21.	Hydroxide		<.1	<.1	<.1	<.1
22.	Iron	<.05	<.05	<.05	<.05	<.05
23.	Lead	<.05	<.009	.01	<.004	<.05
24.	Lithium	<1.0	.04	.3	.2	<.5
25.	Magnesium	19	7.3	4.5	3.8	6.2
26.	Manganese		<.05	<.05	<.05	<.05
27.	Mercury	<.01	<.01	<.01	<.01	<.01
28.	Molybdenum	<.05	0.05	0.02	0.03	
29.	Nickel		.008	0.01	.02	
30.	Nitrate	4.6	<.1	<.1	<.1	0.2
31.	pH	8.8	8.5	8.5	8.6	8.3
32.	Phosphate, Total	<.1	<.1	<.1	<.1	<.1
33.	Potassium		1.3	1.3	1.7	
34.	Selenium	<.01	<.002	<.002	<.004	<.01
35.	Silica	21	13	13	13	11
(*)36.	Silver	.01	.002	.002	.004	0.012
37.	Sodium	195	298	308	302	330
38.	Solids, Dissolved	650	764	750	728	806
39.	Strontium	0	<.002	0.3	0.3	
40.	Sulfate	160	32	4	4	13
41.	Titanium		0.01	0.01	.01	
42.	Vanadium		<.001	<.001	<.004	
43.	Yttrium		<.002	<.001	<.004	
44.	Zinc	<.05	0.06	0.06	0.1	<.5
45.	Zirconium		<.002	<.002	<.004	
46.	Radioactivity					
	Gross Alpha (pcl)		5.3	4.5	5.4	
	Radium 226*		0	0.1	0.2	
	Gross Beta (pcl)		12	6	12	
	Thorium 230**					
	Uranium**					
47.	Total Organic Carbon (TOC)		<.1	<.1	<.1	
	If TOC > 10 mg/l then measure					
	Dissolved Organic Carbon					
	Suspended Organic Carbon					
	Phenols	.001	.001	.001	.01	.001
	Sulfate, Acid Extraction					
	Nitrogen, Base Extraction					

(*) Not required
* Required if gross alpha is greater than 4 picocuries per liter (pcl).
** Required if gross beta is greater than 100 picocuries per liter (pcl).

TABLE II B-10

WATER QUALITY ANALYSIS
DRILLING WATER

Well Number: SG-9 (Unless otherwise stated, all units are mg/l)
Location: 222.2'FSL & 461'FEL, Sec. 11 T3S R97W Elevation: 6870 Grd.

		Depth at Which Sample Taken (ft.)				
	Element Measured	993	1200	1285	1360	2750
1.	Aluminum	5.4	7.4	0.8	0.08	0.2
2.	Ammonia	0.013	0.022	0.025	0.042	
3.	Arsenic	<.003	0.02	0.12	0.007	0.009
4.	Barium	0.02	0.05	0.7	0.5	0.04
5.	Beryllium	<.003	0.001	0.001	.006	<0.001
6.	Bicarbonate	417	461	515	586	650
7.	Bismuth	<.003	<.003	<.009	<.006	<.002
8.	Boron	0.7	0.6	0.6	0.5	0.08
9.	Cadmium	<.003	<.003	<.009	<.006	<.002
10.	Calcium	6.3	4	5	5.2	7
11.	Carbonate	5	0	0	0	0
12.	Cerium	0.002	0.003	<.009	0.004	0.002
13.	Chloride	2	2	1.4	2.3	3.2
14.	Chrome, Hexavalent	<.01	<.01	<.01	<.01	<.01
15.	Cobalt	0.002	0.01	0.03	0.02	0.008
16.	Conductivity, Specific	620	690	820	930	
17.	Copper	0.007	0.1	0.05	0.01	0.02
18.	Fluoride	9	13	14	14	14
19.	Gallium	0.003	<.003	<.009	<.006	<.002
20.	Hardness, Total	52	30	34	38	
21.	Hydroxide	<0.1	<0.1	<0.1	<0.1	
22.	Iron	0.96	0.95	0.08	0.05	0.2
23.	Lead	<.05	<.05	<.05	<.05	0.02
24.	Lithium	.2	.5	.4	.1	0.8
25.	Magnesium	4.9	4.0	3.3	4.4	4.9
26.	Manganese	<.05	<.05	<.05	<.05	0.01
27.	Mercury	.0001	.0001	.0001	.0001	.0028
28.	Molybdenum	<.003	0.006	0.02	0.003	0.02
29.	Nickel	.005	0.05	0.1	0.02	0.02
30.	Nitrate	0.32	0.76	3.35	0.27	0.056
31.	pH	8.5	8.2	8.2	8.0	8.2
32.	Phosphate, Total	<0.1	<0.1	<0.1	<0.1	
33.	Potassium	0.3	0.4	0.7	0.6	1
34.	Selenium	<.003	<.003	0.05	<.006	<.002
35.	Silica	16	13	14	11	11
(*)36.	Silver	<.003	<.003	<.009	<.006	<.002
37.	Sodium	164	182	191	221	232
38.	Solids, Dissolved	424	447	488	555	607
39.	Strontium	5.0	0.3	0.4	0.6	0.4
40.	Sulfate	12	3	6	8.9	15.4
41.	Titanium	0.04	0.03	<.009	0.2	0.05
42.	Vanadium	<.001	0.004	0.008	0.002	0.001
43.	Yttrium	0.001	<.003	<.009	<.006	<.002
44.	Zinc	0.02	0.3	0.4	0.03	0.02
45.	Zirconium	<.003	0.003	0.01	<.006	<.002
46.	Radioactivity					
	Gross Alpha (pcl)	3.4	1.7	5.7	1.5	5.5
	Radium 226*			0.9		0
	Gross Beta (pcl)	0	0	0	0	0
	Thorium 230**					
	Uranium**					
47.	Total Organic Carbon (TOC)	4	4	3	4	1
	If TOC > 10 mg/l then measure Dissolved Organic Carbon					
	Suspended Organic Carbon					
	Phenols					
	Sulfate, Acid Extraction					
	Nitrogen, Base Extraction					

(*) Not required
* Required if gross alpha is greater than 4 picocuries per liter (pcl).
** Required if gross beta is greater than 100 picocuries per liter (pcl).

TABLE II B-11

WATER QUALITY ANALYSIS
DRILLING WATER

Well Number: SG-10 (Unless otherwise stated, all units are mg/l)
Location: 97.0'FNL&184'FEL Sec. 13T3SR97W **Elevation:** 6950 Grd.

		Depth at Which Sample Taken (ft.)				
	Element Measured	960	1336	1416	2211	
1.	Aluminum	0.9	2	2.0	19	
2.	Ammonia	2.1	1.8	1.9	7.0	
3.	Arsenic	.01	.005	<.006	.02	
4.	Barium	.01	.02	0.04	0.2	
5.	Beryllium	<.001	<.001	<.001	<.001	
6.	Bicarbonate	330	518	535	1212	
7.	Bismuth	<.001	<.001	<.001	<.001	
8.	Boron	4.3	1.5	<.001	<.001	
9.	Cadmium	<.01	.003	<.001	<.001	
10.	Calcium	27	8	7.6	14.8	
11.	Carbonate	6	6	23	28	
12.	Cerium	<.001	<.001	<.001	<.001	
13.	Chloride	3.1	0.1	1.4	103	
14.	Chrome, Hexavalent	<.01	<.01	<.01	<.01	
15.	Cobalt	.002	.04	0.04	.004	
16.	Conductivity, Specific					
17.	Copper	0.04	.006	0.006	0.1	
18.	Fluoride	3.0	15	15	17	
19.	Gallium	<.001	.002	.001	.002	
20.	Hardness, Total	180	64	68	54	
21.	Hydroxide	<.1	<.1	<.1	<.1	
22.	Iron	<.05	<.05	0.6	4.	
23.	Lead	<.001	.003	<.001	<.001	
24.	Lithium	<.5	<.5	0.6	<.5	
25.	Magnesium	19	3.8	3.8	7.0	
26.	Manganese	0.05	0.05	0.01	0.2	
27.	Mercury	<.01	<.01	<.01	<.01	
28.	Molybdenum	0.02	.009	0.03	0.03	
29.	Nickel	.01	.01	0.05	0.03	
30.	Nitrate	0.32	0.56	0.74	<.1	
31.	pH	8.4	8.4	8.8	8.5	
32.	Phosphate, Total	<.1	<.1	<.1	<.1	
33.	Potassium	0.4	0.5	0.5	3.2	
34.	Selenium	.001	.02	<.004	<.004	
35.	Silica	21	13	11	15	
(*)36.	Silver	<.01	.005	.001	<.001	
37.	Sodium	146	218	236	570	
38.	Solids, Dissolved	536	531	569	1415	
39.	Strontium	1	0.1	0.6	1	
40.	Sulfate	149	13	9	63	
41.	Titanium	0.3	0.1	0.04	0.5	
42.	Vanadium	.003	.002	.003	0.01	
43.	Yttrium	<.001	<.001	<.001	<.001	
44.	Zinc	.04	.009	0.09	.09	
45.	Zirconium	<.001	.001	<.001	0.01	
46.	Radioactivity Gross Alpha (pcl)	2.9	9.2	1.4	5.1	
	Radium 226*					
	Gross Beta (pcl)	0	0	0	0	
	Thorium 230**					
	Uranium**					
47.	Total Organic Carbon (TOC)	0.7	0.7	31+	9	
	If TOC > 10 mg/l then measure Dissolved Organic Carbon					
	Suspended Organic Carbon					
	Phenols	<.05	<.003	<.003	<.001	
	Sulfate, Acid Extraction					
	Nitrogen, Base Extraction					

(*) Not required
* Required if gross alpha is greater than 4 picocuries per liter (pcl).
** Required if gross beta is greater than 100 picocuries per liter (pcl).

+ Sample checked for benzo(a)pyrene; none found. A check of fecal coliform showed 10,000 colonies/100 ml. Sample obviously contaminated.

TABLE II B-12

WATER QUALITY ANALYSIS
DRILLING WATER

Well Number: SG-11 (Unless otherwise stated, all units are mg/l)
Location: 12'FSL&160'FEL Sec. 7 T3SR96W **Elevation:** 6900 Grd.

		Depth at Which Sample Taken (ft.)					
	Element Measured	808	868	1330	1385	2465	2825
1.	Aluminum	0.6	2.	2.	.6	.03	.02
2.	Ammonia		0.9	<.1	0.3		.2
3.	Arsenic	.03	.02	.03	.02	.01	.02
4.	Barium	.04	.04	.03	.02	.2	0.06
5.	Beryllium	<.001	<0.1	<.009	<.001	<.002	.001
6.	Bicarbonate	441	383	620	564	1036	973
7.	Bismuth	<.001	<.001	<.009	<.009	<.002	<.001
8.	Boron	<.1	<.1	1.0	1.6	0.4	<.1
9.	Cadmium	<.001	<.01	<.009	<.009	<.002	<.001
10.	Calcium	59	33	89	26	18	36
11.	Carbonate	9	8	2	14	26	43
12.	Cerium	<.001	<.001	<.009	<.009	.001	<.001
13.	Chloride	8	6	5	3	101	68
14.	Chrome, Hexavalent	<.01	<.01	<.01	<.01	<.01	<.01
15.	Cobalt	.02	.02	.006	.008	.06	.03
16.	Conductivity, Specific						
17.	Copper	.3	.06	.01	.009	.04	.007
18.	Fluoride	0.4	1.6	4.4	12	14	10
19.	Gallium	.01	<.001	<.009	.008	<.001	<.001
20.	Hardness, Total	350	250	580	140	67	115
21.	Hydroxide	<.1	<.1	<.1	<.1	<.1	<.1
22.	Iron	<.05	<.05	<.05	<.05	<.05	<.05
23.	Lead	<.05	<.05	.04	<.009	0.05	.09
24.	Lithium	.4	.06	.03	.1	<.5	<.001
25.	Magnesium	43	33	78	18	15	28
26.	Manganese	<.05	<.05	.05	<.05	<.05	<.05
27.	Mercury	<.01	<.01	<.01	<.01	<.01	<.01
28.	Molybdenum	0.2	<.001	.2	<.009	<.05	.01
29.	Nickel	.07	.01	.01	.01	0.1	.06
30.	Nitrate	1.7	3.5	<.1	<.1	<.1	<.1
31.	pH	8.4	8.4	8.2	8.5	8.6	8.6
32.	Phosphate, Total	<.1	<.1	<.1	<.1	<.1	<.1
33.	Potassium	0.6	0.8	1.3	1.2	1.5	1.8
34.	Selenium	<.001	<.001	<.009	<.009	<.002	<.001
35.	Silica	24	21	19	11	17	19
(*)36.	Silver	<.001	<.001	<.009	<.009	<.002	
37.	Sodium	165	141	215	211	488	500
38.	Solids, Dissolved	841	634	1150	659	1244	1382
39.	Strontium	7	3	1	0.5	1	1
40.	Sulfate	316	202	433	86	56	199
41.	Titanium	.2	.1	0.1	.04	.2	.07
42.	Vanadium	.01	.003	.007	.003	<.001	<.001
43.	Yttrium	<.001	<.001	.005	<.009	<.001	<.001
44.	Zinc	.06	0.1	.2	.03	.08	<.3
45.	Zirconium	<.001	<.001	<.009	<.009	<.003	.003
46.	Radioactivity Gross Alpha (pcl)						
	Radium 226*						
	Gross Beta (pcl)						
	Thorium 230** Uranium**						
47.	Total Organic Carbon (TOC) If TOC > 10 mg/l then measure Dissolved Organic Carbon						
	Suspended Organic Carbon						
	Phenols	<.005	<.001	<.001	<.001	<.001	<.01
	Sulfate, Acid Extraction						
	Nitrogen, Base Extraction						

(*) Not required
* Required if gross alpha is greater than 4 picocuries per liter (pcl).
** Required if gross beta is greater than 100 picocuries per liter (pcl).

TABLE II B-12a

SG-11

ANALYSIS OF MAJOR CONSTITUENTS

AT 50 FOOT INTERVALS FROM 287' TO 1185'

(Unless otherwise stated, all units are mg/1)

Major Constituents / Depths (Ft.)	287	337	387	437	487	537	587	637	687	737	787	837	885	925	975	1025	1075	1125	1185
Calcium	120	130	130	100	98	88	125	89	67	57	34	89	29	19	9.8	25	21	23	9.8
Magnesium	90	94	110	130	105	110	88	86	75	48	48	86	46	49	33	26	24	23	23
Sodium	220	240	240	240	275	220	260	230	250	230	190	230	175	165	160	155	185	175	235
Carbonate	24	24	24	23	32	30	24	48	42	30	40	48	<.1	22	24	<.1	<.1	<.1	<.1
Bicarbonate	360	360	410	500	570	590	560	530	480	420	360	525	400	395	365	410	435	440	570
Chloride	31	35	42	35	35	42	49	32	35	28	35	31	42	21	28	24	25	20	27
Sulfate	690	780	770	730	650	585	610	480	450	360	240	48	225	185	100	125	120	110	95
Nitrate	<0.1	<.1	<.1	0.1	0.1	<.1	0.2	0.1	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.4	5.3	11	0.4
Phosphate	<0.1	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.01	<.1	0.4
Silica	34	35	45	26	23	32	24	22	32	30	26	22	18	15	22	21	24	20	21
Iron	0.16	0.14	0.05	0.10	0.05	<.05	<.05	<.05	<.05	<.05	<.05	<.05	0.16	0.18	0.32	0.05	0.11	0.25	<.05
Fluoride	<0.1	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.1	0.6	<.1	2.8	4.6	1.2	5	6	7	9
Hardness	670	715	770	770	685	680	670	575	475	340	280	575	260	250	160	170	150	150	120
T.D.S.	1380	1490	1550	1620	1700	1530	1570	1290	1170	980	870	900	810	760	580	565	640	625	610
*Conductance	1810	1870	1960	1990	1870	1840	1850	1740	1610	1340	1140	1160	1140	1050	860				
pH	7.0	8.0	7.9	7.9	7.8	8.0	7.8	8.0	8.0	8.1	8.2	8.0	7.9	8.1	8.2	7.7	7.8	7.8	7.8

*micromhos per c.c.

TABLE II B-13

WATER QUALITY ANALYSIS
DRILLING WATER

Well Number: SG-18 $^{(a)}$ (Unless otherwise stated, all units are mg/l)
Location: 1240.4'FSL 365.7'FEL Sec. 25T3SR97W **Elevation:** 7383 Grd.

		Depth at Which Sample Taken (ft.)				
	Element Measured	960	1380	1425.6		
1.	Aluminum	3.2	<.05	.8		
2.	Ammonia	.2	.3	.3		
3.	Arsenic	<.01	<.01	<.01		
4.	Barium	0.01	0.05	0.03		
5.	Beryllium	<.02	<.001	<.008		
6.	Bicarbonate	460	496	460		
7.	Bismuth	<.02	<.007	<.008		
8.	Boron	0.4	0.6	0.4		
9.	Cadmium	<.01	<.01	<.01		
10.	Calcium	51	4	18		
11.	Carbonate	17	<.1	<.1		
12.	Cerium	<.02	0.005	<.008		
13.	Chloride	6.8	.7	1.4		
14.	Chrome, Hexavalent	<.01	<.01	<.01		
15.	Cobalt	<.02	<.007	0.004		
16.	Conductivity, Specific	710	670	750		
17.	Copper	<.1	<.1	<.1		
18.	Fluoride	9.1	10.1	9.9		
19.	Gallium	<.02	<.007	<.008		
20.	Hardness, Total	152	42	90		
21.	Hydroxide	<.1	<.1	<.1		
22.	Iron	.32	.06	.08		
23.	Lead	<.05	<.05	<.05		
24.	Lithium	<.5	.5	.5		
25.	Magnesium	6.1	4.0	11		
26.	Manganese	<.05	<.05	<.05		
27.	Mercury	<.01	<.01	<.01		
28.	Molybdenum	0.04	0.02	0.02		
29.	Nickel	0.01	0.006	0.008		
30.	Nitrate	<.1	<.1	.1		
31.	pH	8.3	8.0	8.0		
32.	Phosphate, Total	<.1	<.1	<.1		
33.	Potassium		0.4			
34.	Selenium	<.01	<.01	<.01		
35.	Silica	21	13	17		
(*)36.	Silver	.01	.5	.01		
37.	Sodium	169	167	176		
38.	Solids, Dissolved	557	473	501		
39.	Strontium	2	0.3	0.8		
40.	Sulfate	74	1.0	42		
41.	Titanium	0.2	0.1	0.1		
42.	Vanadium	0.004	0.004	0.003		
43.	Yttrium	<.02	0.003	0.003		
44.	Zinc	0.2	0.009	0.03		
45.	Zirconium	0.01	<.007	0.006		
46.	Radioactivity Gross Alpha (pcl)	0.6	1.8	4.0		
	Radium 226*					
	Gross Beta (pcl)	0	0	0		
	Thorium 230**					
	Uranium**					
47.	Total Organic Carbon (TOC) If TOC > 10 mg/l then measure Dissolved Organic Carbon	3	3	3		
	Suspended Organic Carbon					
	Phenols					
	Sulfate, Acid Extraction					
	Nitrogen, Base Extraction					

(*) Not required
* Required if gross alpha is greater than 4 picocuries per liter (pcl).
** Required if gross beta is greater than 100 picocuries per liter (pcl).

(a) SG-18 abandoned with fish in the hole.

TABLE II B-14

WATER QUALITY ANALYSIS
DRILLING WATER

Well Number: SG-19 (Unless otherwise stated, all units are mg/l)

Location: 139.8'FNL&456.8'FWL Sec. 5 T3SR96W Elevation: 6370 Grd

		Depth at Which Sample Taken (ft.)				
	Element Measured	466	860	981(1)		
1.	Aluminum	5.4	3.2	<.05		
2.	Ammonia	.3	.4	.7		
3.	Arsenic	<.01	<.01	.01		
4.	Barium	0.2	0.2	0.2		
5.	Beryllium	<.006	<.008	<.002		
6.	Bicarbonate	480	1160	1760		
7.	Bismuth	<.006	<.008	<.002		
8.	Boron	.4	.4	.4		
9.	Cadmium	<.01	<.01	<.01		
10.	Calcium	8.6	7.8	11		
11.	Carbonate	17	81	70		
12.	Cerium	.006	<.008	.001		
13.	Chloride	9.5	6.8	<.1		
14.	Chrome, Hexavalent	<.01	<.01	<.01		
15.	Cobalt	.002	.003	.005		
16.	Conductivity, Specific	720	1640	2350		
17.	Copper	<.1	<.1	<.1		
18.	Fluoride	9.3	10	10		
19.	Gallium	<.006	<.008	<.002		
20.	Hardness, Total	27	23	28		
21.	Hydroxide	<.1	<.1	<.1		
22.	Iron	1.06	1.0	<.5		
23.	Lead	<.05	<.05	<.05		
24.	Lithium	<.5	<.5	<.5		
25.	Magnesium	1.3	.9	<.1		
26.	Manganese	<.05	<.05	<.05		
27.	Mercury	<.01	<.01	<.01		
28.	Molybdenum	.01	.07	.009		
29.	Nickel	.007	.02	.01		
30.	Nitrate	2.3	<.1	<.1		
31.	pH	8.3	8.7	8.6		
32.	Phosphate, Total	<.1	<.1	<.1		
33.	Potassium	.4	.6	.9		
34.	Selenium	<.006	<.008	<.002		
35.	Silica	10	11	8.4		
(*)36.	Silver	<.01	<.01	<.01		
37.	Sodium	220	527	762		
38.	Solids, Dissolved	523	1210	1720		
39.	Strontium	0.2	0.4	0.3		
40.	Sulfate	9.4	<4.0	<4		
41.	Titanium	.07	0.2	.05		
42.	Vanadium	.002	.003	<.001		
43.	Yttrium	<.006	<.008	<.002		
44.	Zinc	.02	<.5	.006		
45.	Zirconium	<.006	<.008	.003		
46.	Radioactivity					
	Gross Alpha (pcl)	2.8	0.7	0		
	Radium 226*					
	Gross Beta (pcl)	0	0	0		
	Thorium 230**					
	Uranium**					
47.	Total Organic Carbon (TOC)	4	4	3		
	If TOC > 10 mg/l then measure					
	Dissolved Organic Carbon					
	Suspended Organic Carbon					
	Phenols					
	Sulfate, Acid Extraction					
	Nitrogen, Base Extraction					

(*) Not required

* Required if gross alpha is greater than 4 picocuries per liter (pcl).

** Required if gross beta is greater than 100 picocuries per liter (pcl).

1. Sample taken upon reaching total depth 981'.

WATER QUALITY ANALYSES

ALLUVIAL WELLS

TRACT C-b

THE INDUSTRIAL LABORATORIES COMPANY

Analytical and Consulting Chemists

2600 WEST 29TH AVENUE
DENVER, COLORADO 80211
ANALYSIS REPORT

TELEPHONE 455-3641

ATLANTIC RICHFIELD COMPANY

DATE RECEIVED:	10/17/74
DATE REPORTED:	10/29/74
LAB. NUMBER:	3765

SAMPLES ARE DISCARDED IN 15 DAYS FROM DATE OF REPORT UNLESS WE ARE REQUESTED, IN WRITING, TO RETAIN THEM FOR A LONGER PERIOD. PERISHABLE SAMPLES ARE USUALLY DISCARDED IMMEDIATELY UNLESS CLIENT HAS REQUESTED SPECIAL HANDLING (FREEZING, ETC.) IN ADVANCE.

MPLE MARKED: A-1

ANALYSIS:

	MILLIGRAMS PER LITER	MILLI-EQUIVALENTS
Calcium	80	3.992
Magnesium	80	6.584
Sodium	270	11.745
Carbonate	Less than 0.1	-----
Bicarbonate	663	10.873
Chloride	15	0.423
Sulfate	530	11.024
Nitrate	0.3	-----
Phosphate	Less than 0.1	-----
Silicon dioxide	17	0.566
Iron	9.4	0.508
Fluoride	3.4	
Hardness, in terms of calcium carbonate	530	
Ammonia	Less than 0.1	
Lithium	Less than 0.5	
Barium	Less than 1.0	
Hexavalent chromium	Less than 0.01	
Arsenic	Less than 0.01	
Selenium	Less than 0.01	
Boron	0.6	
Hydroxide	Less than 0.1	
Aluminum	0.32	
Copper	Less than 0.1	
Cadmium	0.01	
Lead	Less than 0.05	

Σ Cations = 22.33
Σ Anions = 22.52
% Difference = 0.4

	MILLIGRAMS PER LITER
Manganese	0.96
Zinc	Less than 0.5
Silver	Less than 0.01
Mercury	Less than 0.01
Total dissolved solids (calculated)	1,330

pH 7.8
Specific conductance 1,790 micromhos per cc

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CHEMIST

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Analytical and Consulting Chemists

2600 WEST 29TH AVENUE
DENVER, COLORADO 80211
TELEPHONE 455-3641

ANALYSIS REPORT

ATLANTIC RICHFIELD COMPANY

DATE RECEIVED: 10/17/74
DATE REPORTED: 10/29/74

LAB. NUMBER: 3766

SAMPLES ARE DISCARDED IN 15 DAYS FROM DATE OF REPORT UNLESS WE ARE REQUESTED, IN WRITING, TO RETAIN THEM FOR A LONGER PERIOD. PERISHABLE SAMPLES ARE USUALLY DISCARDED IMMEDIATELY UNLESS CLIENT HAS REQUESTED SPECIAL HANDLING (FREEZING, ETC.) IN ADVANCE.

AMPLE MARKED: A-2

ANALYSIS:

	MILLIGRAMS PER LITER	MILLI-EQUIVALENTS
Calcium	52	2.595
Magnesium	65	5.267
Sodium	255	11.093
Carbonate	Less than 0.1	-----
Bicarbonate	586	9.610
Chloride	10	0.282
Sulfate	415	8.632
Nitrate	0.6	-----
Phosphate	1.1	-----
Silicon dioxide	22	0.733
Iron	3.5	-----
Fluoride	5.0	0.257
Hardness, in terms of calcium carbonate	395	
Ammonia	0.6	
Lithium	Less than 0.5	
Barium	Less than 1.0	
Hexavalent chromium	Less than 0.01	
Arsenic	Less than 0.01	
Selenium	Less than 0.01	
Boron	1.7	
Hydroxide	Less than 0.1	
Aluminum	0.34	
Copper	Less than 0.1	
[illegible]	[illegible]	
Cadmium	0.12	
Lead	Less than 0.05	

Σ Cations = 18.96
Σ Anions = 18.79
% Difference = 0.5

	MILLIGRAMS PER LITER
Manganese	1.5
Silver	Less than 0.01
Zinc	Less than 0.5
Mercury	Less than 0.01
Total dissolved solids (calculated)	1,110

pH 7.4
Specific conductance 1,240 micromhos per cc

MEM[illegible] OF:

AMERICAN ASS'N OF CEREAL CHEMISTS
AMERICAN CHEMICAL SOCIETY
AMERICAN OIL CHEMISTS' SOCIETY
ASS'N OF OFFICIAL RACING CHEMISTS
BAKERY ENGINEERS OF AMERICA
INSTITUTE OF FOOD TECHNOLOGY
SIGMA XI

THE INDUSTRIAL LABORATORIES COMPANY
H. Paul Ochs
CHEMIST

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THE INDUSTRIAL LABORATORIES COMPANY

Analytical and Consulting Chemists

2600 WEST 29TH AVENUE
DENVER, COLORADO 80211
ANALYSIS REPORT

TELEPHONE 455-3641

ATLANTIC RICHFIELD COMPANY

DATE RECEIVED: 10/17/74
DATE REPORTED: 10/29/74

LAB. NUMBER: 3767

SAMPLES ARE DISCARDED IN 15 DAYS FROM DATE OF REPORT UNLESS WE ARE REQUESTED, IN WRITING, TO RETAIN THEM FOR A LONGER PERIOD. PERISHABLE SAMPLES ARE USUALLY DISCARDED IMMEDIATELY UNLESS CLIENT HAS REQUESTED SPECIAL HANDLING (FREEZING, ETC.) IN ADVANCE.

AMPLE MARKED: A-3 107 Feet

ANALYSIS:

	MILLIGRAMS PER LITER	MILLI-EQUIVALENTS
Calcium	58	2.894
Magnesium	45	3.703
Sodium	250	10.875
Carbonate	Less than 0.1	-----
Bicarbonate	562	9.217
Chloride	7.6	------
Sulfate	400	8.320
Nitrate	3.0	------
Phosphate	0.3	-----
Silicon dioxide	18	0.599
Iron	Less than 0.05	
Fluoride	1.9	
Hardness, in terms of calcium carbonate	330	
Ammonia	Less than 0.1	
Lithium	Less than 0.5	
Barium	Less than 1.0	
Hexavalent chromium	Less than 0.01	
Arsenic	Less than 0.01	
Selenium	Less than 0.01	
Boron	0.7	
Hydroxide	Less than 0.1	
Aluminum	0.14	
Copper	Less than 0.1	
Cadmium	0.016	
Manganese	2.2	
Silver	Less than 0.01	

Σ Cations = 17.47
Σ Anions = 17.64
% Difference = 0.5

	MILLIGRAMS PER LITER
Zinc	Less than 0.5
Mercury	Less than 0.01
Lead	0.05
Total dissolved solids (calculated)	1,050

pH 7.5
Specific conductance 1,480 micromhos per cc

cc: John Matis/Frank Haas

OF:

AMERICAN ASS'N OF CEREAL CHEMISTS
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ASS'N OF OFFICIAL RACING CHEMISTS
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ANALYSIS REPORT

TELEPHONE 455-3641

DATE RECEIVED: 10/17/74
DATE REPORTED: 10/29/74

ATLANTIC RICHFIELD COMPANY

LAB. NUMBER: 3708

SAMPLES ARE DISCARDED IN 15 DAYS FROM DATE OF REPORT UNLESS WE ARE REQUESTED, IN WRITING, TO RETAIN THEM FOR A LONGER PERIOD. PERISHABLE SAMPLES ARE USUALLY DISCARDED IMMEDIATELY UNLESS CLIENT HAS REQUESTED SPECIAL HANDLING (FREEZING, ETC.) IN ADVANCE.

SAMPLE MARKED: A-5 86

ANALYSIS:

	MILLIGRAMS PER LITER	MILLI-EQUIVALENTS
Calcium	36	1.800
Magnesium	64	5.259
Sodium	290	12.615
Carbonate	Less than 0.1	-----
Bicarbonate	516	8.462
Chloride	15	0.423
[illegible]lfate	500	10.400
[illegible]trate	2.2	-----
Phosphate	0.2	-----
Silicon dioxide	17	0.566
Iron	Less than 0.05	
Fluoride	1.5	
Hardness, in terms of calcium carbonate	352	
Ammonia	Less than 0.1	
Lithium	Less than 0.5	
Barium	Less than 1.0	
Hexavalent chromium	Less than 0.01	
Arsenic	Less than 0.01	
Selenium	Less than 0.01	
Boron	1.2	
Hydroxide	Less than 0.1	
Aluminum	0.06	
Copper	Less than 0.1	
Cadmium	Less than 0.01	
Lead	0.07	

Σ Cations = 19.67
Σ Anions = 19.37
% Difference - 0.8

	MILLIGRAMS PER LITER
Manganese	2.3
Silver	0.012
Zinc	Less than 0.5
Mercury	Less than 0.01
Total dissolved solids (calculated)	1,215

pH 7.8
Specific conductance 1,480 micromhos per cc

cc: Frank Haas/John Matis

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ANALYSIS REPORT

ATLANTIC RICHFIELD COMPANY

DATE RECEIVED: 10/17/74
DATE REPORTED: 10/29/74

LAB. NUMBER: 3769

SAMPLES ARE DISCARDED IN 15 DAYS FROM DATE OF REPORT UNLESS WE ARE REQUESTED, IN WRITING, TO RETAIN THEM FOR A LONGER PERIOD. PERISHABLE SAMPLES ARE USUALLY DISCARDED IMMEDIATELY UNLESS CLIENT HAS REQUESTED SPECIAL HANDLING (FREEZING, ETC.) IN ADVANCE.

AMPLE MARKED: A-6 10/9/74

ANALYSIS:

	MILLIGRAMS PER LITER		MILLI-EQUIVALENTS
Calcium	30		1.497
Magnesium	70		5.761
Sodium	295		12.833
Carbonate	Less than 0.1	Σ Cations = 20.09	-----
Bicarbonate	670	Σ Anions = 19.99	10.983
		% Difference = 0.2	
Chloride	17		0.479
[illegible]ate	405		8.424
[illegible]ate	3.5		-----
Phosphate	0.3		------
Silicon dioxide	20		0.666

Iron	Less than 0.05
Fluoride	1.9
Hardness, in terms of calcium carbonate	360
Ammonia	0.1
Lithium	Less than 0.5
Barium	Less than 1.0
Hexavalent chromium	Less than 0.01
Arsenic	Less than 0.01
Selenium	Less than 0.01
Boron	1.4
Hydroxide	Less than 0.1
Aluminum	Less than 0.05
Copper	Less than 0.1
Cadmium	Less than 0.01
Lead	0.066

	MILLIGRAMS PER LITER
Manganese	0.12
Silver	Less than 0.01
Zinc	Less than 0.5
Mercury	Less than 0.01
Total dissolved solids (calculated)	1,170

pH 7.4

Specific conductance 1,540 micromhos per cc

MEM[illegible] OF: cc: John Hatis/Frank Haas

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THE INDUSTRIAL LABORATORIES COMPANY

H. Paul Wells

CHEMIST

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ANALYSIS REPORT

ATLANTIC RICHFIELD COMPANY

DATE RECEIVED: 10/17/74
DATE REPORTED: 10/29/74

LAB. NUMBER: 3770

SAMPLES ARE DISCARDED IN 15 DAYS FROM DATE OF REPORT UNLESS WE ARE REQUESTED, IN WRITING, TO RETAIN THEM FOR A LONGER PERIOD. PERISHABLE SAMPLES ARE USUALLY DISCARDED IMMEDIATELY UNLESS CLIENT HAS REQUESTED SPECIAL HANDLING (FREEZING, ETC.) IN ADVANCE.

SAMPLE MARKED: A-7 10/8/74

ANALYSIS:

	MILLIGRAMS PER LITER	MILLI-EQUIVALENTS
Calcium	16	0.798
Magnesium	20	1.646
Sodium	375	16.313
Carbonate	18	0.599
Bicarbonate	405	5.642
Chloride	11	0.310
Sulfate	475	9.888
Nitrate	4.3	-----
Phosphate	0.4	-----
Silicon dioxide	41	1.365

Σ Cations = 18.76
Σ Anions = 17.96
% Difference = 2.2

	MILLIGRAMS PER LITER
Iron	Less than 0.05
Fluoride	8.0
Hardness, in terms of calcium carbonate	122
Ammonia	0.1
Lithium	Less than 0.5
Barium	Less than 1.0
Hexavalent chromium	Less than 0.01
Arsenic	Less than 0.01
Selenium	Less than 0.01
Boron	1.4
Hydroxide	Less than 0.1
Aluminum	Less than 0.05
Cadmium	Less than 0.01
Copper	Less than 0.1
Lead	Less than 0.05

	MILLIGRAMS PER LITER
Manganese	0.74
Silver	Less than 0.01
Zinc	Less than 0.5
Mercury	Less than 0.01
Total dissolved solids (calculated)	1,166

pH	8.4
Specific conductance	1,180 micromhos per cc

cc: Frank Haas/John Matis

[illegible] OF:

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THE INDUSTRIAL LABORATORIES COMPANY

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ANALYSIS REPORT

DATE RECEIVED: 10/17/74
DATE REPORTED: 10/[illegible]/74

LAB. NUMBER: 3771

ATLANTIC RICHFIELD COMPANY

SAMPLES ARE DISCARDED IN 15 DAYS FROM DATE OF REPORT UNLESS WE ARE REQUESTED, IN WRITING, TO RETAIN THEM FOR A LONGER PERIOD. PERISHABLE SAMPLES ARE USUALLY DISCARDED IMMEDIATELY UNLESS CLIENT HAS REQUESTED SPECIAL HANDLING (FREEZING, ETC.) IN ADVANCE.

MPLE MARKED: A-8 70 Feet 10/9/74

ANALYSIS:

	MILLIGRAMS PER LITER		MILLI-EQUIVALENTS
Calcium	56		2.794
Magnesium	60		4.938
Sodium	290		12.615
Carbonate	Less than 0.1	Σ Cations = 20.35	-----
Bicarbonate	630	Σ Anions = 20.36	10.332
Chloride	3.5	% Difference = <0.1	-----
Sulfate	480		9.994
Nitrate	3.5		------
Phosphate	Less than 0.1		-----
Silicon dioxide	16		0.533
Iron	Less than 0.05		-----
Fluoride	0.8		

			MILLIGRAMS PER LITER
Hardness, in terms of calcium carbonate	386	Manganese	2.1
Ammonia	0.1	Silver	Less than 0.01
Lithium	Less than 0.5	Zinc	Less than 0.5
		Mercury	Less than 0.01
Barium	Less than 1.0	Total dissolved solids (calculated)	1,218
Hexavalent chromium	Less than 0.01		
Selenium	Less than 0.01		
Arsenic	Less than 0.01		
Boron	0.7		
		pH	7.6
Hydroxide	Less than 0.1	Specific conductance	1,400 micromhos per cc
Aluminum	Less than 0.05		
Copper	Less than 0.1		
Cadmium	Less than 0.01		
Lead	0.07		

MEM OF: cc: John Matis/Frank Haas

AMERICAN ASS'N OF CEREAL CHEMISTS
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THE INDUSTRIAL LABORATORIES COMPANY

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THE INDUSTRIAL LABORATORIES COMPANY
Analytical and Consulting Chemists
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ANALYSIS REPORT

ATLANTIC RICHFIELD COMPANY

DATE RECEIVED: 10/17/74
DATE REPORTED: 10/29/74

LAB. NUMBER: 3772

SAMPLES ARE DISCARDED IN 15 DAYS FROM DATE OF REPORT UNLESS WE ARE REQUESTED, IN WRITING, TO RETAIN THEM FOR A LONGER PERIOD. PERISHABLE SAMPLES ARE USUALLY DISCARDED IMMEDIATELY UNLESS CLIENT HAS REQUESTED SPECIAL HANDLING (FREEZING, ETC.) IN ADVANCE.

MPLE MARKED: A-8 (No date) Small Bottles

ANALYSIS:	MILLIGRAMS PER LITER	MILLI-EQUIVALENTS
Calcium	74	3.693
Magnesium	75	6.173
Sodium	170	7.395
Carbonate	Less than 0.1	-----
Bicarbonate	530	8.692
Chloride	4.2	-----
Sulfate	415	8.632
Nitrate	5.1	----
Phosphate	Less than 0.1	-----
Silicon dioxide	14	0.466
Iron	3.4	
Fluoride	0.8	
Hardness, in terms of calcium carbonate	490	
Ammonia	0.1	
Lithium	Less than 0.5	
Barium	Less than 1.0	
Hexavalent chromium	Less than 0.01	
Arsenic	Less than 0.01	
Selenium	Less than 0.01	
Boron	0.6	
Hydroxide	Less than 0.1	
Aluminum	0.55	
Copper	Less than 0.1	
Cadmium	Less than 0.01	
Lead	Less than 0.05	

Σ Cations = 17.26
Σ Anions = 17.37
% Difference = 0.3

	MILLIGRAMS PER LITER
Manganese	0.49
Silver	Less than 0.01
Zinc	Less than 0.5
Mercury	Less than 0.01
Total dissolved solids (calculated)	607

pH 7.9
Specific conductance 1,300 micromhos per cc

OF: cc: Frank Haas/John Matis

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AMERICAN OIL CHEMISTS' SOCIETY
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THE INDUSTRIAL LABORATORIES COMPANY
H. Paul Ochs
CHEMIST

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ANALYSIS REPORT

DATE RECEIVED: 10/17/74
DATE REPORTED: 10/29/74

ATLANTIC RICHFIELD COMPANY

LAB. NUMBER: 3773

SAMPLES ARE DISCARDED IN 15 DAYS FROM DATE OF REPORT UNLESS WE ARE REQUESTED, IN WRITING, TO RETAIN THEM FOR A LONGER PERIOD. PERISHABLE SAMPLES ARE USUALLY DISCARDED IMMEDIATELY UNLESS CLIENT HAS REQUESTED SPECIAL HANDLING (FREEZING, ETC.) IN ADVANCE.

SAMPLE MARKED: A-9 57 Feet 10/9/74

ANALYSIS:

	MILLIGRAMS PER LITER		MILLI-EQUIVALENTS
Calcium	49		2.445
Magnesium	57		6.502
Sodium	150		6.525
Carbonate	Less than 0.0	Σ Cations = 15.47	-----
Bicarbonate	450	Σ Anions = 15.02	7.380
		% Difference = 1.5	
Chloride	3.5		------
Sulfate	360		7.488
Nitrate	6.6		0.106
Phosphate	Less than 0.1		------
Silicon dioxide	14		0.466
Iron	Less than 0.05		
Fluoride	0.8		
Hardness, in terms of calcium carbonate	358		
Ammonia	0.2		
Lithium	Less than 0.5		
Barium	Less than 1.0		
Hexavalent chromium	Less than 0.01		
Arsenic	Less than 0.01		
Selenium	Less than 0.01		
Boron	0.7		
Hydroxide	Less than 0.1		
Aluminum	Less than 0.05		
Copper	Less than 0.1		
Cadmium	Less than 0.01		
Lead	Less than 0.05		

	MILLIGRAMS PER LITER
Manganese	0.70
Silver	Less than 0.01
Zinc	Less than 0.5
Mercury	Less than 0.01
Total dissolved solids (calculated)	861

pH 7.4
Specific conductance 1,000 micromhos per cc

cc: John Matis/Frank Haas

THE INDUSTRIAL LABORATORIES COMPANY
H. Paul Ochs
CHEMIST

MEMBER OF:
AMERICAN ASS'N OF CEREAL CHEMISTS
AMERICAN CHEMICAL SOCIETY
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THE INDUSTRIAL LABORATORIES COMPANY

Analytical and Consulting Chemists

2600 WEST 29TH AVENUE
DENVER, COLORADO 80211
ANALYSIS REPORT

TELEPHONE 455-3641

DATE RECEIVED: 10/17/74
DATE REPORTED: 10.29/74

ATLANTIC RICHFIELD COMPANY

LAB. NUMBER: 3774

SAMPLES ARE DISCARDED IN 15 DAYS FROM DATE OF REPORT UNLESS WE ARE REQUESTED, IN WRITING, TO RETAIN THEM FOR A LONGER PERIOD. PERISHABLE SAMPLES ARE USUALLY DISCARDED IMMEDIATELY UNLESS CLIENT HAS REQUESTED SPECIAL HANDLING (FREEZING, ETC.) IN ADVANCE.

SAMPLE MARKED: A-10 07

ANALYSIS:

	MILLIGRAMS PER LITER		MILLI-EQUIVALENTS
Calcium	69		3.443
Magnesium	79		6.502
Sodium	160		6.960
Carbonate	Less than 0.1	Σ Cations = 16.91	------
Bicarbonate	436	Σ Anions = 16.51	7.105
		% Difference = 1.2	
Chloride	4.8		----
Sulfate	450		9.360
Nitrate	9.1		------
Phosphate	Less than 0.1		-----
Silicon dioxide	14		0.466
Iron	0.17		
Fluoride	0.8		
Hardness, in terms of calcium carbonate	498		
Ammonia	Less than 0.1		
Lithium	Less than 0.5		
Barium	Less than 1.0		
Hexavalent chromium	Less than 0.01		
Arsenic	Less than 0.01		
Selenium	Less than 0.01		
Boron	0.7		
Hydroxide	Less than 0.1		
Aluminum	0.25		
Copper	Less than 0.1		
Cadmium	Less than 0.01		
Lead	Less than 0.05		

	MILLIGRAMS PER LITER
Manganese	0.92
Silver	Less than 0.01
Zinc	Less than 0.5
Mercury	Less than 0.01
Total dissolved solids (calculated)	1,000

pH 8.0
Specific conductance 1,270 micromhos per cc

MEM[illegible] OF: CC: John Hatis/Frank Haas

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THE INDUSTRIAL LABORATORIES COMPANY

CHEMIST

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ANALYSIS REPORT

ATLANTIC RICHFIELD COMPANY

DATE RECEIVED: 10/17/74
DATE REPORTED: 10/20/74

LAB. NUMBER: 3775

SAMPLES ARE DISCARDED IN 15 DAYS FROM DATE OF REPORT UNLESS WE ARE REQUESTED, IN WRITING, TO RETAIN THEM FOR A LONGER PERIOD. PERISHABLE SAMPLES ARE USUALLY DISCARDED IMMEDIATELY UNLESS CLIENT HAS REQUESTED SPECIAL HANDLING (FREEZING, ETC.) IN ADVANCE.

AMPLE MARKED: A-11 66 Feet 10/9/74

ANALYSIS:

	MILLIGRAMS PER LITER	MILLI-EQUIVALENTS
Calcium	61	3.044
Magnesium	85	6.995
Sodium	185	8.047
Carbonate	Less than 0.1	-----
Bicarbonate	475	7.790
Chloride	4.2	-----
Sulfate	475	9.880
Nitrate	3.1	-----
Phosphate	Less than 0.1	-----
Silicon dioxide	14	0.466
Iron	1.3	
Fluoride	0.5	
Hardness, in terms of calcium carbonate	502	
Ammonia	Less than 0.1	
Lithium	Less than 0.5	
Barium	Less than 1.0	
Hexavalent chromium	Less than 0.01	
Arsenic	Less than 0.01	
Selenium	Less than 0.01	
Boron	0.6	
Hydroxide	Less than 0.1	
Aluminum	0.52	
Copper	Less than 0.1	
Cadmium	Less than 0.01	
Lead	Less than 0.05	

Σ Cations = 18.09
Σ Anions = 17.67
% Difference = 1.2

	MILLIGRAMS PER LITER
Manganese	0.52
Silver	Less than 0.01
Zinc	Less than 0.5
Mercury	Less than 0.01
Total dissolved solids (calculated)	1,062

pH 7.4
Specific conductance 1,400 micromhos per cc

MEM[illegible] OF:

AMERICAN ASS'N OF CEREAL CHEMISTS
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ANALYSIS REPORT

ATLANTIC RICHFIELD COMPANY

DATE RECEIVED: 10/17/74
DATE REPORTED: 10/29/74

LAB. NUMBER: 3776

SAMPLES ARE DISCARDED IN 15 DAYS FROM DATE OF REPORT UNLESS WE ARE REQUESTED, IN WRITING, TO RETAIN THEM FOR A LONGER PERIOD. PERISHABLE SAMPLES ARE USUALLY DISCARDED IMMEDIATELY UNLESS CLIENT HAS REQUESTED SPECIAL HANDLING (FREEZING, ETC.) IN ADVANCE.

AMPLE MARKED: A-11 No date Small bottle

ANALYSIS:

	MILLIGRAMS PER LITER	MILLI-EQUIVALENTS
Calcium	71	3.543
Magnesium	95	7.819
Sodium	210	9.135
Carbonate	Less than 0.1	------
Bicarbonate	510	8.364
Chloride	4.8	------
Sulfate	530	11.024
Nitrate	3.3	-----
Phosphate	Less than 0.1	-----
Silicon dioxide	13	0.433
Iron	2.8	-----
Fluoride	0.5	
Hardness, in terms of calcium carbonate	565	
Ammonia	Less than 0.1	
Lithium	Less than 0.5	
Barium	Less than 1.0	
Hexavalent chromium	Less than 0.01	
Arsenic	Less than 0.01	
Selenium	Less than 0.01	
Boron	0.7	
Hydroxide	Less than 0.1	
Aluminum	0.54	
Copper	Less than 0.1	
Cadmium	Less than 0.01	
Lead	Less than 0.05	

Σ Cations = 20.50
Σ Anions = 19.39
% Difference = 2.8

	MILLIGRAMS PER LITER
Manganese	Kš 0.41
Silver	Less than 0.01
Zinc	Less than 0.5
Mercury	Less than 0.01
Total dissolved solids (calculated)	1,109

pH 7.7
Specific conductance 1,480 micromhos per cc

cc: John Matis/Frank Haas

Mem[illegible]OF:

AMERICAN ASS'N OF CEREAL CHEMISTS
AMERICAN CHEMICAL SOCIETY
AMERICAN OIL CHEMISTS' SOCIETY
ASS'N OF OFFICIAL RACING CHEMISTS
BAKERY ENGINEERS OF AMERICA
INSTITUTE OF FOOD TECHNOLOGY
SIGMA XI

THE INDUSTRIAL LABORATORIES COMPANY
H. Paul Ochs
CHEMIST

THIS REPORT IS NOT TO BE REPRODUCED, IN WHOLE OR IN PART, FOR ADVERTISING PURPOSES WITHOUT OBTAINING PRIOR WRITTEN AUTHORIZATION

THE INDUSTRIAL LABORATORIES COMPANY

Analytical and Consulting Chemists

2600 WEST 29TH AVENUE
DENVER, COLORADO 80211
TELEPHONE 455-3641

ANALYSIS REPORT

ATLANTIC RICHFIELD COMPANY

DATE RECEIVED: 10/17/74
DATE REPORTED: 10/29/74

LAB. NUMBER: 3777

SAMPLES ARE DISCARDED IN 15 DAYS FROM DATE OF REPORT UNLESS WE ARE REQUESTED, IN WRITING, TO RETAIN THEM FOR A LONGER PERIOD. PERISHABLE SAMPLES ARE USUALLY DISCARDED IMMEDIATELY UNLESS CLIENT HAS REQUESTED SPECIAL HANDLING (FREEZING, ETC.) IN ADVANCE.

AMPLE MARKED: A-12 78 Feet 10/9/74

ANALYSIS:

	MILLIGRAMS PER LITER	MILLI-EQUIVALENTS
Calcium	105	5.240
Magnesium	53	4.362
Sodium	730	10.005
Carbonate	Less than 0.1	-----
Bicarbonate	585	9.594
Chloride	3.5	-----
Sulfate	480	9.984
Nitrate	2.9	-------
Phosphate	Less than 0.1	-----
Silicon dioxide	15	0.500

Σ Cations = 19.61
Σ Anions = 19.58
√ % Difference = <0.1

	MILLIGRAMS PER LITER
Iron	2.8
Fluoride	0.7
Hardness, in terms of calcium carbonate	473
Ammonia	0.1
Lithium	Less than 0.5
Barium	Less than 1.0
Hexavalent chromium	Less than 0.01
Arsenic	Less than 0.01
Selenium	Less than 0.01
Boron	1.2
Hydroxide	Less than 0.1
Aluminum	0.17
Copper	Less than 0.1
Cadmium	Less than 0.01
Lead	Less than 0.05

	MILLIGRAMS PER LITER
Manganese	0.09
Silver	Less than 0.01
Zinc	Less than 0.5
Mercury	Less than 0.01
Total dissolved solids (calculated)	1,179

pH 7.3
Specific conductance 1,510 micromhos per cc

cc: John Matis/Frank Haas

II B-215

THE INDUSTRIAL LABORATORIES COMPANY
H. Paul Ochs
CHEMIST

MEMBERS OF:
AMERICAN ASS'N OF CEREAL CHEMISTS
AMERICAN CHEMICAL SOCIETY
AMERICAN OIL CHEMISTS' SOCIETY
ASS'N OF OFFICIAL RACING CHEMISTS
BAKERY ENGINEERS OF AMERICA
INSTITUTE OF FOOD TECHNOLOGY
SIGMA XI

THIS REPORT IS NOT TO BE REPRODUCED, IN WHOLE OR IN PART, FOR ADVERTISING PURPOSES WITHOUT OBTAINING PRIOR WRITTEN AUTHORIZATION

COMMERCIAL TESTING & ENGINEERING CO.
GENERAL OFFICES: 228 NORTH LA SALLE STREET, CHICAGO, ILLINOIS 60601 · AREA CODE 312 726-8434

SINCE 1908

Reply to
Instrumental Analysis Division
14335 West 44th Avenue
Golden, Colorado 80401

Phone: 303-278-9521

12 November 74

Mr. Frank Haas
The Oil Shale Corporation
18200 WEst Hiway 72
Golden, Colorado 80401

Re: IAD #97-140-002-33

ANALYTICAL REPORT

Sample	TOC* mg/liter	Nitrate** mg/liter N	Free Ammonia** mg/liter N
[illegible]-1	7	0.12	<0.005
A-2 @ 82'	7	0.36	0.040
A-3 @ 107'	7	0.76	<0.005
A-5 @ 86'	7	0.48	<0.005
A-6 @ 60'	7	0.70	<0.005
A-7 @ 51'	8	2.15	<0.005
A-8	4	1.02	<0.005
A-8 @ 70'	8	1.04	<0.005
A-9 @ 57'	6	1.25	<0.005
A-10 @ 67'	3	2.39	<0.005
A-11 @ 66'	3	0.99	<0.005
A-12 @ 78'	3	1.20	<0.005

* Test performed on samples marked 'Regular'
** Test performed on samples marked 'Hg for N'

Charles R. Wilson
Charles R. Wilson, Analyst

M L Jacobs
Approved by:
M. L. Jacobs, Ph.D.
Divisional Manager

CRW/dh

COMMERCIAL TESTING & ENGINEERING CO.

GENERAL OFFICES: 228 NORTH LA SALLE STREET, CHICAGO, ILLINOIS 60601 · AREA CODE 312 726-8434

Reply to INSTRUMENTAL ANALYSIS DIVISION, 14335 WEST AVENUE, GOLDEN, COLORADO, 80401, PHONE: 303-278-9521

To: Mr. Frank Haas
The Oil Shale Corporation
18200 West Hiway 72
Golden, Colorado 80401

Date: 8 November 74

Analyst: S. Sweeney

P. O. No.:

Sample No.: A-1

IAD No.: 97-140-002-33

CONCENTRATION IN μg/ml

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium		Terbium		Ruthenium		Vanadium	0.02
Thorium		Gadolinium		Molybdenum	0.02	Titanium	1
Bismuth		Europium		Niobium		Scandium	0.01
Lead	0.03	Samarium		Zirconium		Calcium	*
Thallium	**0.0003	Neodymium		Yttrium		Potassium	*
Mercury		Praseodymium		Strontium	1	Chlorine	*
Gold		Cerium	0.02	Rubidium	0.05	Sulfur	*
Platinum		Lanthanum	0.005	Bromine	0.03	Phosphorus	1
Iridium		Barium	0.2	Selenium		Silicon	*
Osmium		Cesium		Arsenic	0.005	Aluminum	≃12
Rhenium		Iodine	0.004	Germanium		Magnesium	*
Tungsten		Tellurium		Gallium		Sodium	*
Tantalum		Antimony		Zinc	0.5	Fluorine	*
Hafnium		Tin		Copper	0.05	Oxygen	NR
Lutetium		Indium	STD	Nickel	0.05	Nitrogen	NR
Ytterbium		Cadmium		Cobalt	0.02	Carbon	NR
Thulium		Silver		Iron	≃16	Boron	0.04
Erbium		Palladium		Manganese	0.5	Beryllium	<0.001
Holmium		Rhodium		Chromium	0.02	Lithium	0.4
Dysprosium						Hydrogen	NR

NR — Not Reported
All elements not reported <0.005 μg/ml
* Not reported upon request
** Flameless Atomic Absorption

II B-218

Approved: M E Jacobs

COMMERCIAL TESTING & ENGINEERING CO.
GENERAL OFFICES: 228 NORTH LA SALLE STREET, CHICAGO, ILLINOIS 60601 · AREA CODE 312 726-8434
Reply to INSTRUMENTAL ANALYSIS DIVISION, 14335 WEST AVENUE, GOLDEN, COLORADO, 80401, PHONE: 303-278-9521

Mr. Frank Haas
The Oil Shale Corporation
18200 West Hiway 72
Golden, Colorado 80401

Date: 8 November 74

Analyst: S. Sweeney

P. O. No.:

Sample No.: A-2 at 82'

IAD No.: 97-140-002-33

CONCENTRATION IN μg/ml

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium		Terbium		Ruthenium		Vanadium	0.02
Thorium		Gadolinium		Molybdenum	0.005	Titanium	0.4
Bismuth		Europium		Niobium		Scandium	0.005
Lead	0.03	Samarium		Zirconium	0.005	Calcium	*
Thallium		Neodymium		Yttrium	0.003	Potassium	*
Mercury	**0.0002	Praseodymium	0.002	Strontium	2	Chlorine	*
[illegible]ld		Cerium	0.01	Rubidium	0.02	Sulfur	*
Platinum		Lanthanum	0.01	Bromine	0.02	Phosphorus	7
Iridium		Barium	0.1	Selenium		Silicon	*
Osmium		Cesium		Arsenic	0.01	Aluminum	≈30
Rhenium		Iodine		Germanium	0.003	Magnesium	*
Tungsten		Tellurium		Gallium	0.01	Sodium	*
Tantalum		Antimony		Zinc	0.05	Fluorine	*
Hafnium		Tin		Copper	0.03	Oxygen	NR
Lutetium		Indium	STD	Nickel	0.05	Nitrogen	NR
Ytterbium		Cadmium		Cobalt	0.05	Carbon	NR
Thulium		Silver		Iron	≈15	Boron	0.02
Erbium		Palladium		Manganese	≈7	Beryllium	<0.001
Holmium		Rhodium		Chromium	0.02	Lithium	0.3
[illegible]ysprosium						Hydrogen	NR

II B-219

NR – Not Reported
All elements not reported <0.003 μg/ml
* Not reported upon request
** Flameless Atomic Absorption

Approved: M Jacobs

COMMERCIAL TESTING & ENGINEERING CO.
GENERAL OFFICES: 228 NORTH LA SALLE STREET, CHICAGO, ILLINOIS 60601 · AREA CODE 312 726-8434
INSTRUMENTAL ANALYSIS DIVISION, 14335 WEST AVENUE, GOLDEN, COLORADO, 80401, PHONE: 303-278-9521

Reply to

To: Mr. Frank Haas
The Oil Shale Corporation
18200 West Hiway 72
Golden, Colorado 80401

Date: 8 November 74

Analyst: S. Sweeney

P. O. No.:

Sample No.: A-3 @ 107'

IAD No.: 97-140-002-33

CONCENTRATION IN μg/ml

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium		Terbium		Ruthenium		Vanadium	0.01
Thorium		Gadolinium		Molybdenum	0.02	Titanium	***0.7
Bismuth		Europium		Niobium		Scandium	0.005
Lead	0.03	Samarium		Zirconium		Calcium	*
Thallium		Neodymium		Yttrium	0.006	Potassium	*
Mercury	**0.0003	Praseodymium		Strontium	2	Chlorine	*
Gold		Cerium	0.02	Rubidium	0.01	Sulfur	*
Platinum		Lanthanum	0.01	Bromine	0.02	Phosphorus	2
Iridium		Barium	0.2	Selenium		Silicon	*
Osmium		Cesium		Arsenic	0.004	Aluminum	≈57
Rhenium		Iodine	0.003	Germanium		Magnesium	*
Tungsten		Tellurium		Gallium		Sodium	*
Tantalum		Antimony		Zinc	0.3	Fluorine	*
Hafnium		Tin		Copper	0.1	Oxygen	NR
Lutetium		Indium	STD	Nickel	0.07	Nitrogen	NR
Ytterbium		Cadmium		Cobalt	0.02	Carbon	NR
Thulium		Silver		Iron	7	Boron	0.05
Erbium		Palladium		Manganese	4	Beryllium	0.001
Holmium		Rhodium		Chromium	0.02	Lithium	0.2
Dysprosium						Hydrogen	NR

NR -- Not Reported
All elements not reported <0.006 μg/ml
* Not reported upon request
** Flameless Atomic Absorption
*** Heterogeneous

Approved:

COMMERCIAL TESTING & ENGINEERING CO.

GENERAL OFFICES: 228 NORTH LA SALLE STREET, CHICAGO, ILLINOIS 60001 · AREA CODE 312 726-8434
Reply to INSTRUMENTAL ANALYSIS DIVISION, 14335 WEST AVENUE, GOLDEN, COLORADO, 80401, PHONE: 303-278-9521

To: Mr. Frank Haas
The Oil Shale Corporation
18200 West Hiway 72
Golden, Colorado 80401

Date: 8 November 74

Analyst: S. Sweeney

P. O. No.:

Sample No.: A-5 @ 86'

IAD No.: 97-140-002-33

CONCENTRATION IN μg/ml

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium		Terbium		Ruthenium		Vanadium	0.03
Thorium		Gadolinium		Molybdenum	0.02	Titanium	1
Bismuth		Europium		Niobium	0.004	Scandium	0.01
Lead		Samarium		Zirconium	0.01	Calcium	*
Thallium		Neodymium		Yttrium	0.004	Potassium	*
Mercury	**0.0001	Praseodymium		Strontium	4	Chlorine	*
Gold		Cerium	0.007	Rubidium	0.05	Sulfur	*
Platinum		Lanthanum	0.006	Bromine	0.09	Phosphorus	1
Iridium		Barium	0.6	Selenium	0.06	Silicon	*
Osmium		Cesium		Arsenic	0.05	Aluminum	≈30
Rhenium		Iodine	0.01	Germanium	0.03	Magnesium	*
Tungsten		Tellurium		Gallium	0.03	Sodium	*
Tantalum		Antimony		Zinc	1	Fluorine	*
Hafnium		Tin	0.02	Copper	0.1	Oxygen	NR
Lutetium		Indium	STD	Nickel	0.09	Nitrogen	NR
Ytterbium		Cadmium		Cobalt	0.04	Carbon	NR
Thulium		Silver		Iron	≈14	Boron	0.2
Erbium		Palladium		Manganese	≈18	Beryllium	
Holmium		Rhodium		Chromium	0.004	Lithium	0.5
Dysprosium						Hydrogen	NR

NR — Not Reported
All elements not reported <0.01 μg/ml
* Not reported upon request
** Flameless Atomic Absorption

II B-221

Approved: M L Jacobs

COMMERCIAL TESTING & ENGINEERING CO.
GENERAL OFFICES: 228 NORTH LA SALLE STREET, CHICAGO, ILLINOIS 60601 · AREA CODE 312 726-8434
Reply to INSTRUMENTAL ANALYSIS DIVISION, 14335 WEST AVENUE, GOLDEN, COLORADO, 80401, PHONE: 303-278-9521

Mr. Frank Haas
The Oil Shale Corporation
18200 West Hiway 72
Golden, Colorado

Date: 8 November 74

Analyst: S. Sweeney

P. O. No.:

Sample No.: A-6 @ 60'

IAD No.: 97-140-002-33

CONCENTRATION IN µg/ml

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium		Terbium		Ruthenium		Vanadium	0.002
Thorium		Gadolinium		Molybdenum		Titanium	0.08
Bismuth		Europium		Niobium		Scandium	0.005
Lead	0.1	Samarium		Zirconium		Calcium	*
Thallium		Neodymium		Yttrium	0.001	Potassium	*
Mercury	**0.0017	Praseodymium	0.002	Strontium	3	Chlorine	*
[illegible]ld		Cerium	0.01	Rubidium	0.004	Sulfur	*
Platinum		Lanthanum	0.007	Bromine	0.02	Phosphorus	3
Iridium		Barium	0.03	Selenium		Silicon	*
Osmium		Cesium		Arsenic	0.004	Aluminum	≈26
Rhenium		Iodine	0.002	Germanium		Magnesium	*
Tungsten		Tellurium		Gallium		Sodium	*
Tantalum		Antimony		Zinc	0.2	Fluorine	*
Hafnium		Tin		Copper	0.09	Oxygen	NR
Lutetium		Indium	STD	Nickel	0.02	Nitrogen	NR
Ytterbium		Cadmium		Cobalt	0.004	Carbon	NR
Thulium		Silver		Iron	3	Boron	0.02
Erbium		Palladium		Manganese	0.3	Beryllium	
Holmium		Rhodium		Chromium	0.02	Lithium	1
[illegible]sprosium						Hydrogen	NR

NR — Not Reported
All elements not reported <0.003 µg/ml
* Not reported upon request
** Flameless Atomic Absorption

Approved: M J Jacobs

COMMERCIAL TESTING & ENGINEERING CO.
GENERAL OFFICES: 228 NORTH LA SALLE STREET, CHICAGO, ILLINOIS 60601 · AREA CODE 312 726-8434
Reply to INSTRUMENTAL ANALYSIS DIVISION, 14335 WEST AVENUE, GOLDEN, COLORADO, 80401, PHONE: 303-278-9521

[illegible]: Mr. Frank Haas
The Oil Shale Corporation
18200 West Hiway 72
Golden, Colorado 80401

Date: 8 November 74

Analyst: S. Sweeney

P. O. No.:

Sample No.: A-7 @ 51'

IAD No.: 97-140-002-33

CONCENTRATION IN μg/ml

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium		Terbium		Ruthenium		Vanadium	0.006
Thorium		Gadolinium		Molybdenum	0.01	Titanium	0.1
Bismuth		Europium		Niobium		Scandium	0.003
Lead		Samarium		Zirconium		Calcium	*
Thallium		Neodymium		Yttrium	0.001	Potassium	*
Mercury	**0.0002	Praseodymium		Strontium	2	Chlorine	*
[illegible]ld		Cerium		Rubidium	0.03	Sulfur	*
Platinum		Lanthanum	0.002	Bromine	0.05	Phosphorus	1
Iridium		Barium	0.4	Selenium		Silicon	*
Osmium		Cesium		Arsenic	0.02	Aluminum	3
Rhenium		Iodine	0.002	Germanium	0.005	Magnesium	*
Tungsten		Tellurium		Gallium	0.002	Sodium	*
Tantalum		Antimony		Zinc	0.06	Fluorine	*
Hafnium		Tin		Copper	0.04	Oxygen	NR
Lutetium		Indium	STD	Nickel	0.02	Nitrogen	NR
Ytterbium		Cadmium		Cobalt	0.3	Carbon	NR
Thulium		Silver		Iron	0.8	Boron	0.06
Erbium		Palladium		Manganese	***5	Beryllium	
Holmium		Rhodium		Chromium	0.01	Lithium	1
[illegible]sprosium						Hydrogen	NR

II B-223

NR – Not Reported
All elements not reported <0.003μg/ml
* Not reported upon request
** Flameless Atomic Absorption
***Heterogeneous

Approved: M J Jacobs

COMMERCIAL TESTING & ENGINEERING CO.
GENERAL OFFICES: 228 NORTH LA SALLE STREET, CHICAGO, ILLINOIS 60601 • AREA CODE 312 726-8434
Reply to INSTRUMENTAL ANALYSIS DIVISION, 14335 WEST AVENUE, GOLDEN, COLORADO, 80401, PHONE: 303-278-9521

[illegible]: Mr. Frank Haas
The Oil Shale Corporation
18200 West Hiway 72
Golden, Colorado 80401

Date: 8 November 74

Analyst: S. Sweeney

P. O. No.:

Sample No.: A-8

IAD No.: 97-140-002-33

CONCENTRATION IN μg/ml

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium		Terbium		Ruthenium		Vanadium	0.03
Thorium		Gadolinium		Molybdenum	0.01	Titanium	0.3
Bismuth		Europium		Niobium	<0.001	Scandium	0.004
Lead	0.02	Samarium		Zirconium	0.004	Calcium	*
Thallium		Neodymium	0.004	Yttrium	0.004	Potassium	*
Mercury	**0.0003	Praseodymium	0.001	Strontium	0.8	Chlorine	*
[illegible]ld		Cerium	0.02	Rubidium	0.03	Sulfur	*
Platinum		Lanthanum	0.007	Bromine	0.009	Phosphorus	2
Iridium		Barium	0.1	Selenium		Silicon	*
Osmium		Cesium	0.002	Arsenic	0.004	Aluminum	>13
Rhenium		Iodine	0.001	Germanium	0.002	Magnesium	*
Tungsten		Tellurium		Gallium	0.001	Sodium	*
Tantalum		Antimony	0.001	Zinc	0.06	Fluorine	*
Hafnium		Tin	0.01	Copper	0.07	Oxygen	NR
Lutetium		Indium	STD	Nickel	<0.01	Nitrogen	NR
Ytterbium		Cadmium		Cobalt	0.01	Carbon	NR
Thulium		Silver		Iron	≈42	Boron	0.01
Erbium		Palladium		Manganese	3	Beryllium	<0.001
Holmium		Rhodium		Chromium	0.01	Lithium	0.5
[illegible]ysprosium						Hydrogen	NR

NR — Not Reported
All elements not reported <0.001 μg/ml
* Not reported upon request
** Flameless Atomic Absorption

II B-224

Approved: M J Jacobs

COMMERCIAL TESTING & ENGINEERING CO.
GENERAL OFFICES: 228 NORTH LA SALLE STREET, CHICAGO, ILLINOIS 60001 • AREA CODE 312 726-8434
Reply to INSTRUMENTAL ANALYSIS DIVISION, 14335 WEST AVENUE, GOLDEN, COLORADO, 80401, PHONE: 303-278-9521

[illegible]o: Mr. Frank Haas
The Oil Shale Corporation
18200 West Hiway 72
Golden, Colorado 80401

Date: 8 November 74

Analyst: S. Sweeney

P. O. No.:

Sample No.: A-8 70'

IAD No.: 97-140-002-33

CONCENTRATION IN µg/ml

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium		Terbium		Ruthenium		Vanadium	0.01
Thorium		Gadolinium		Molybdenum	0.04	Titanium	0.2
Bismuth		Europium		Niobium		Scandium	0.002
Lead	0.07	Samarium		Zirconium		Calcium	*
Thallium		Neodymium		Yttrium		Potassium	*
Mercury	**0.0012	Praseodymium		Strontium	3	Chlorine	*
[illegible]old		Cerium	0.006	Rubidium	0.01	Sulfur	*
Platinum		Lanthanum		Bromine	0.03	Phosphorus	0.3
Iridium		Barium	0.04	Selenium		Silicon	*
Osmium		Cesium		Arsenic		Aluminum	8
Rhenium		Iodine		Germanium		Magnesium	*
Tungsten		Tellurium		Gallium	0.007	Sodium	*
Tantalum		Antimony		Zinc	0.5	Fluorine	*
Hafnium		Tin		Copper	0.1	Oxygen	NR
Lutetium		Indium	STD	Nickel	0.01	Nitrogen	NR
Ytterbium		Cadmium		Cobalt	0.002	Carbon	NR
Thulium		Silver		Iron	2	Boron	0.02
Erbium		Palladium		Manganese	0.2	Beryllium	
Holmium		Rhodium		Chromium	0.01	Lithium	0.5
[illegible]sprosium						Hydrogen	NR

NR — Not Reported
All elements not reported <0.008µg/ml
* Not reported upon request
** Flameless Atomic Absorption

II B-225

Approved:

COMMERCIAL TESTING & ENGINEERING CO.
GENERAL OFFICES: 228 NORTH LA SALLE STREET, CHICAGO, ILLINOIS 60601 · AREA CODE 312 726-8434
Reply to INSTRUMENTAL ANALYSIS DIVISION, 14335 WEST AVENUE, GOLDEN, COLORADO, 80401, PHONE: 303-278-9521

[illegible]: Mr. Frank Haas
The Oil Shale Corporation
18200 West Hiway 72
Golden, Colorado 80401

Date: 8 November 74

Analyst: S. Sweeney

P. O. No.:

Sample No.: A-9 @57'

IAD No.: 97-140-002-33

CONCENTRATION IN µg/ml

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium		Terbium		Ruthenium		Vanadium	0.02
Thorium		Gadolinium		Molybdenum	0.02	Titanium	0.3
Bismuth		Europium		Niobium		Scandium	0.002
Lead	0.01	Samarium		Zirconium	0.01	Calcium	*
Thallium		Neodymium	0.006	Yttrium	0.002	Potassium	*
Mercury	**0.0001	Praseodymium	0.001	Strontium	***2	Chlorine	*
[illegible]ld		Cerium	0.002	Rubidium	0.02	Sulfur	*
Platinum		Lanthanum	0.004	Bromine	0.009	Phosphorus	0.9
Iridium		Barium	0.2	Selenium		Silicon	*
Osmium		Cesium		Arsenic	0.003	Aluminum	≥22
Rhenium		Iodine	0.002	Germanium		Magnesium	*
Tungsten		Tellurium		Gallium	0.004	Sodium	*
Tantalum		Antimony		Zinc	0.1	Fluorine	*
Hafnium		Tin		Copper	0.01	Oxygen	NR
Lutetium		Indium	STD	Nickel	0.04	Nitrogen	NR
Ytterbium		Cadmium		Cobalt	0.02	Carbon	NR
Thulium		Silver		Iron	≈11	Boron	0.05
Erbium		Palladium		Manganese	9	Beryllium	0.001
Holmium		Rhodium		Chromium	0.01	Lithium	0.8
[illegible]sprosium						Hydrogen	NR

II B-226

NR – Not Reported
All elements not reported <0.002 µg/ml
* Not reported upon request
** Flameless Atomic Absorption
*** Heterogeneous

Approved: N L Jacobs

COMMERCIAL TESTING & ENGINEERING CO.
GENERAL OFFICES: 228 NORTH LA SALLE STREET, CHICAGO, ILLINOIS 60601 · AREA CODE 312 726-8434
Reply to INSTRUMENTAL ANALYSIS DIVISION, 14335 WEST AVENUE, GOLDEN, COLORADO, 80401, PHONE: 303-278-9521

[illegible]: Mr. Frank Haas
The Oil Shale Corporation
18200 West Hiway 72
Golden, Colorado 80401

Date: 8 November 74

Analyst: S. Sweeney

P. O. No.:

Sample No.: A-10 @ 67'

IAD No.: 97-140-002-33

CONCENTRATION IN µg/ml

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium		Terbium		Ruthenium		Vanadium	0.009
Thorium		Gadolinium		Molybdenum	***0.02	Titanium	0.1
Bismuth		Europium		Niobium		Scandium	0.002
Lead	0.01	Samarium		Zirconium	0.002	Calcium	*
Thallium		Neodymium		Yttrium	0.002	Potassium	*
Mercury	**<0.0001	Praseodymium		Strontium	0.7	Chlorine	*
[illegible]old		Cerium	0.003	Rubidium	0.02	Sulfur	*
Platinum		Lanthanum	0.002	Bromine	0.02	Phosphorus	3
Iridium		Barium	0.05	Selenium		Silicon	*
Osmium		Cesium		Arsenic	0.001	Aluminum	≈22
Rhenium		Iodine	0.001	Germanium		Magnesium	*
Tungsten		Tellurium		Gallium		Sodium	*
Tantalum		Antimony		Zinc	0.05	Fluorine	*
Hafnium		Tin		Copper	0.03	Oxygen	NR
Lutetium		Indium	STD	Nickel	0.02	Nitrogen	NR
Ytterbium		Cadmium		Cobalt	0.003	Carbon	NR
Thulium		Silver		Iron	4	Boron	0.02
Erbium		Palladium		Manganese	0.8	Beryllium	<0.001
Holmium		Rhodium		Chromium	0.01	Lithium	0.3
[illegible]ysprosium						Hydrogen	NR

II B-227

NR – Not Reported
All elements not reported <0. 002 µg/ml
* Not reported upon request
** Flameless Atomic Absorption
*** Heterogeneous

Approved: M Jacobs

COMMERCIAL TESTING & ENGINEERING CO.
GENERAL OFFICES: 228 NORTH LA SALLE STREET, CHICAGO, ILLINOIS 60601 · AREA CODE 312 726-8434
Reply to INSTRUMENTAL ANALYSIS DIVISION, 14335 WEST AVENUE, GOLDEN, COLORADO, 80401, PHONE: 303-278-9521

To: Mr. Frank Haas
The Oil Shale Corporation
18200 West Hiway 72
Golden, Colorado 80401

Date: 8 November 74

Analyst: S. Sweeney

P. O. No.:

Sample No.: A-11 @ 66'(Green Ink)

IAD No.: 97-140-002-33

CONCENTRATION IN μg/ml

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium		Terbium		Ruthenium		Vanadium	0.2
Thorium		Gadolinium		Molybdenum	0.2	Titanium	2
Bismuth		Europium		Niobium		Scandium	0.009
Lead	0.2	Samarium		Zirconium		Calcium	*
Thallium		Neodymium		Yttrium		Potassium	*
Mercury	**0.0003	Praseodymium		Strontium	3	Chlorine	*
Gold		Cerium	0.01	Rubidium	0.06	Sulfur	*
Platinum		Lanthanum	0.01	Bromine	0.05	Phosphorus	2
Iridium		Barium	0.1	Selenium		Silicon	*
Osmium		Cesium		Arsenic	0.009	Aluminum	≈55
Rhenium		Iodine		Germanium		Magnesium	*
Tungsten		Tellurium		Gallium		Sodium	*
Tantalum		Antimony		Zinc	0.4	Fluorine	*
Hafnium		Tin		Copper	0.2	Oxygen	NR
Lutetium		Indium	STD	Nickel	0.1	Nitrogen	NR
Ytterbium		Cadmium		Cobalt	0.02	Carbon	NR
Thulium		Silver		Iron	≈20	Boron	0.07
Erbium		Palladium		Manganese	2	Beryllium	
Holmium		Rhodium		Chromium	0.06	Lithium	2
Dysprosium						Hydrogen	NR

NR -- Not Reported
All elements not reported <0. 02 μg/ml
* Not reported upon request
** Flameless Atomic Absorption

Approved: M J Jacobs

COMMERCIAL TESTING & ENGINEERING CO.
GENERAL OFFICES: 228 NORTH LA SALLE STREET, CHICAGO, ILLINOIS 60601 · AREA CODE 312 726-8434
Reply to INSTRUMENTAL ANALYSIS DIVISION, 14335 WEST AVENUE, GOLDEN, COLORADO, 80401, PHONE: 303-278-9521

[illegible]o: Mr. Frank Haas
The Oil Shale Corporation
18200 West Hiway 72
Golden, Colorado 80401

Date: 8 November 74

Analyst: S. Sweeney

P. O. No.:

Sample No.: A-12 @ 78'

IAD No.: 97-140-002-33

CONCENTRATION IN µg/ml

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium		Terbium		Ruthenium		Vanadium	0.01
Thorium		Gadolinium		Molybdenum		Titanium	0.4
Bismuth		Europium		Niobium		Scandium	0.02
Lead	0.07	Samarium		Zirconium		Calcium	*
Thallium		Neodymium		Yttrium	0.007	Potassium	*
Mercury	**0.0002	Praseodymium		Strontium	3	Chlorine	*
[illegible]old		Cerium		Rubidium	0.009	Sulfur	*
Platinum		Lanthanum		Bromine	0.05	Phosphorus	0.9
Iridium		Barium	0.04	Selenium		Silicon	*
Osmium		Cesium		Arsenic	0.008	Aluminum	≈20
Rhenium		Iodine		Germanium		Magnesium	*
Tungsten		Tellurium		Gallium		Sodium	*
Tantalum		Antimony		Zinc	0.4	Fluorine	*
Hafnium		Tin		Copper	0.03	Oxygen	NR
Lutetium		Indium	STD	Nickel	0.02	Nitrogen	NR
Ytterbium		Cadmium		Cobalt	0.009	Carbon	NR
Thulium		Silver		Iron	3	Boron	0.07
Erbium		Palladium		Manganese	0.7	Beryllium	
Holmium		Rhodium		Chromium	0.02	Lithium	0.06
[illegible]ysprosium						Hydrogen	NR

NR – Not Reported
All elements not reported <0.02 µg/ml
* Not reported upon request
** Flameless Atomic Absorption

II B-229

Approved: M Jacobs

HAZEN [illegible]EARCH, INC.
4601 Indiana Street
Golden, Colorado 80401

Mr. Frank Haas
The Oil Shale Corporation
18200 West Highway 72
Golden, Colorado 80401

RECEIVED
DEC 3 1974

Date: November 27, 1974
HRI Project No. 535
HRI Series No. 7515
Samples received: Oct. 22, 1974

TOSCO-G REPORT OF ANALYSIS

Analysis No.	Sample Description	pCi/l α Total	±	α Precision*	pCi/l β Total	±	β Precision*	pCi/l Ra^{226}	±	Precision*
7515-1	Stewart Gulch-Spring at Mouth	3.4	±	2.7	0	±	11			
-2	Middle Stewart Gulch	2.8	±	2.5	0	±	12			
-3	Savage Cabin-Stewart Gulch	4.0	±	2.5	0	±	11			
-4	East Stewart Gulch	2.1	±	2.2	0	±	12			
-5	Spring at Oland House	4.6	±	2.8	0	±	12			
-6	Willow Creek West of PL Ranch	3.3	±	2.6	0	±	12			
-7	Willow Creek 3/4 mi. past Scandard	4.7	±	2.8	0	±	12	0	±	0.8
-8	Willow Creek 2 mi. past Scandard	1.3	±	2.1	0	±	12			
-9	Willow Creek Mouth-Scandard	4.2	±	2.8	0	±	12	0.3	±	0.5
-10	Spring-PL Ranch	1.6	±	2.2	0	±	12			
-11✓	A-1	4.3	±	3.4	0	±	15	0.2	±	0.5
-12✓	A-2 85'	2.3	±	3.6	0	±	14			
-13✓	A-3 107'	0	±	3.1	0	±	14			
-14✓	A-5 86'	0	±	3.0	0	±	14			
-15✓	A-6 60'	2.9	±	4.2	0	±	15			
-16✓	A-7 57'	14	±	6	6	±	21	0.3	±	0.4
-17✓	A-8	0	±	2.9	9	±	14			
-18✓	A-8 70'	1.5	±	3.7	0	±	14			
-19✓	A-9 57'	0	±	2.6	0	±	13			
-20	9 Core Point-1200'	1.7	±	1.8	0	±	13			

*Variability of the radioactive disintegration process (counting error) at the 95% confidence level, 1.96σ

HAZEN [illegible]EARCH, INC.
4601 [illegible]ana Street
Golden, Colorado 80401

Mr. Frank Haas
The Oil Shale Corporation

Date: November 27, 1974
HRI Project No. 535
HRI Series No. 7515
Samples received: Oct. 22, 1974

REPORT OF ANALYSIS

		pCi/l			pCi/l			pCi/l		
Analysis No.	Sample Description	α Total	±	α Precision*	β Total	±	β Precision*	Ra^{226}	±	Precision*
7515-21	9 Bottom-1360'	1.5	±	2.7	0	±	15			
-22	Top of parachute 9 Creek-993'	3.4	±	2.1	0	±	13			
-23	Top of mining zone 9-1285'	5.7	±	2.7	0	±	14	0.9	±	0.6
-24 ✓	A-10 67'	2.3	±	2.5	0	±	14			
-25 ✓	A-11 66'	2.2	±	2.6	0	±	14			
-26 ✓	A-11 66'	5.0	±	3.2	0	±	15	0	±	0.3
-27 ✓	A-12 78'	1.6	±	2.4	0	±	14			
-28	18-Base 1425.6'	4.0	±	2.2	0	±	13			
-29	18-1380'	1.8	±	1.9	0	±	13			
-30	Top of para. 18-960'	0.6	±	1.7	0	±	13			
-31	Top of para. 19-466'	2.8	±	2.1	0	±	13			
-32	19-860'	0.7	±	2.6	0	±	15			
-33	19-TD-981'	0	±	3.4	0	±	33			

*Variability of the radioactive disintegration process (counting error) at the 95% confidence level, 1.96σ

By:
John C. Jarvis
Manager, Analytical Laboratory

ljb

WATER QUALITY ANALYSES

AT - 1

TRACT C-b

Table 1

COREHOLE AT-1
MAJOR CONSTITUENTS, 952 FEET

Element	C & L	TOSCO	Industrial Laboratories
Sodium, mg/l	156	136	320
Potassium, mg/l	0.6	0.6	N.D.
Calcium, mg/l	37	32	43
Magnesium, mg/l	22	24	20
Sulfate, mg/l	215	183	210
Carbonate, mg/l	12	7	28
Bicarbonate, mg/l	372	357	670
Chloride, mg/l	0.9	0.9	33
Fluoride, mg/l	2.7	2.1	4.0
Σ Cations, meq/l	10.48	9.53	17.71
Σ Anions, meq/l	11.35	10.03	17.49
% Difference	4.0	2.6	0.6
Silica, mg/l	23	21	23
pH	8.4	8.5	8.3
Calculated TDS, mg/l	660	582	1,009

N.D. Not Determined

Table 2

COREHOLE AT-1
MINOR CONSTITUENTS, 952 FEET

Element	Industrial Laboratories	C & L	Hazen Research
Cyanide, mg/l	<0.01	<0.05	
Phosphate, mg/l	<0.1	0.05	
Lithium, mg/l	<0.5	0.04	
Phenols, mg/l	<0.001	<0.05	
Sulfide, mg/l	<0.1	0.40	
Ammonia, mg/l	1.8	0.39	
Nitrite, mg/l	<0.1	0.05	
Nitrate, mg/l	<0.1	0.21	
Total Organic Carbon, mg/l		7	
Oil and Grease		0.003	
Color		3	
Odor		2	
Gross α, pCi/l			13 ± 3
Radium 226, pCi/l			2.3 ± 1.4
Gross β, pCi/l			8 ± 9

C & L LABORATORIES

Elemental Analysis — Mass Spectrometry

General Analytical Services

14335 West 44th Ave
Golden, Colo. 80401
(303) 278-9521

To: Mr. Frank Haas
The Oil Shale Corp.
18200 West Hiway 72
Golden, CO 80401

Date: 8-5-74

Analyst: S. Sweeney

C & L No.: 97-074-002-03

Customer No.:
Sample No.: TOSCO 952' depth Aquifer Test #1, Top of Parachute Creek

CONCENTRATION IN PPM WEIGHT

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium		Terbium		Ruthenium		Vanadium	0.01
Thorium		Gadolinium		Molybdenum	0.03	Titanium	0.1
Bismuth		Europium		Niobium	0.0006	Scandium	0.005
Lead		Samarium		Zirconium	0.001	Calcium	*
Thallium		Neodymium		Yttrium		Potassium	*
Mercury	*	Praseodymium		Strontium	6	Chlorine	*
Gold		Cerium		Rubidium	0.03	Sulfur	*
Platinum		Lanthanum		Bromine	0.003	Phosphorus	*
Iridium		Barium	0.04	Selenium		Silicon	*
Osmium		Cesium		Arsenic	0.2	Aluminum	18
Rhenium		Iodine		Germanium	0.002	Magnesium	*
Tungsten	**	Tellurium		Gallium	0.001	Sodium	*
Tantalum	**	Antimony		Zinc	0.09	Fluorine	*
Hafnium		Tin		Copper	0.1	Oxygen	NR
Lutetium		Indium	STD	Nickel	0.02	Nitrogen	NR
Ytterbium		Cadmium		Cobalt	0.04	Carbon	NR
Thulium		Silver		Iron	6	Boron	0.01
Erbium		Palladium		Manganese	0.1	Beryllium	
Holmium		Rhodium		Chromium	0.1	Lithium	*
Dysprosium						Hydrogen	NR

NR - Not Reported <0.001 µg/ml *Reported by different methods
All elements not reported
**Source Contamination

THE INDUSTRIAL LABORATORIES COMPANY

Analytical and Consulting Chemists

2600 WEST 29TH AVENUE
DENVER, COLORADO 80211
ANALYSIS REPORT

TELEPHONE 455-3641

Don - what
11 + 3

ATLANTIC RICHFIELD COMPANY
2 Park Central, Suite 555
1515 Arapahoe Street
Denver, Colorado 80202

Attn: John Matis

DATE RECEIVED: 7/9/74
DATE REPORTED: 7/12/74

LAB. NUMBER: 1231

SAMPLES ARE DISCARDED IN 15 DAYS FROM DATE OF REPORT UNLESS WE ARE REQUESTED, IN WRITING, TO RETAIN THEM FOR A LONGER PERIOD. PERISHABLE SAMPLES ARE USUALLY DISCARDED IMMEDIATELY UNLESS CLIENT HAS REQUESTED SPECIAL HANDLING (FREEZING, ETC.) IN ADVANCE.

JT#1

SAMPLE MARKED: Sorghum Gulch Top—Parachute 952'

ANALYSIS:	MILLIGRAMS PER LITER	MILLI-EQUIVALENTS	
Calcium (Ca)	43	2.15	
Magnesium (Mg)	20	1.65	
Sodium (Na)	320	14.04	13.91
Carbonate (CO_3)	28	0.93	
Bicarbonate (HCO_3)	670	11.05	10.98
Chloride (Cl)	33	0.93	
Sulfate (SO_4)	210	4.37	
Nitrate (NO_3)	Less than 0.1	----	
Phosphate (PO_4)	Less than 0.1	----	
Silicon dioxide	23	0.60	
Iron (Fe)	0.07	0.---	
Fluoride (F)	4.0	0.21	
P. alkalinity, in terms of calcium carbonate	23		
MO alkalinity, in terms of calcium carbonate	570		
Hardness, in terms of calcium carbonate	190		
pH	8.3		
Turbidity	5 units		
Total dissolved solids	820		
C.O.D.	21		
MB-AS	Less than 0.5		
Phenols	Less than 0.001		
Cyanide (Cn)	Less than 0.01		
Nitrite (NO_2)	Less than 0.1		
Sulfur (S)	Less than 0.1		
Lithium (Li)	Less than 0.5		
Barium (Ba)	Less than 1.0		
Hexavalent chromium	Less than 0.01		

	MILLIGRAMS PER LITER
Arsenic (As)	0.02
Selenium (Se)	Less than 0.01
Cadmium (Cd)	Less than 0.01
Copper (Cu)	Less than 0.1
Boron (B)	2.5
Manganese (Mn)	Less than 0.05
Silver (Ag)	Less than 0.01
Zinc (Zn)	Less than 0.5
Mercury (Hg)	Less than 0.01
Hydroxide	Less than 0.1
Residual chlorine	Less than 0.1
Beryllium	Less than 0.1
Molybdenum	Less than 0.1
Lead (Pb)	Less than 0.05
Ammonia-nitrogen	1.8

MEMBERS OF:

AMERICAN ASS'N OF CEREAL CHEMISTS
AMERICAN CHEMICAL SOCIETY
AMERICAN OIL CHEMISTS' SOCIETY
ASS'N OF OFFICIAL RACING CHEMISTS
BAKERY PRODUCERS OF AMERICA
INSTITUTE OF FOOD TECHNOLOGY
SIGMA XI

THE INDUSTRIAL LABORATORIES COMPANY

Paul Oeller

CHEMIST

THIS REPORT IS NOT TO BE REPRODUCED, IN WHOLE OR IN PART, FOR ADVERTISING PURPOSES WITHOUT OBTAINING PRIOR WRITTEN AUTHORIZATION

WATER QUALITY ANALYSES

AT - 1a

TRACT C-b

Table 1

MAJOR CONSTITUENT ANALYSES
CORE HOLE AT 1-1A

	960 Feet		1344 Feet		1424 Feet		1620 Feet		
Element	Industrial	TOSCO	Industrial	TOSCO	Industrial	TOSCO	Industrial	C&L	TOSCO
Sodium, mg/l	220	156	290	248	300	250	300	240	246
Potassium, mg/l		0.3		0.5		0.5		0.3	0.5
Calcium, mg/l	17	11	14	10	11	11	9.8	14	10
Magnesium, mg/l	13	21	7.1	6	9.1	6	7.2	4	5
Sulfate, mg/l	185	195	65	47	52	39	37	41	24
Carbonate, mg/l	37	4	25	12	28	14	31	35	14
Bicarbonate, mg/l	320	337	600	570	610	586	620.	598	583
Chloride, mg/l	24	4	20	3	28	2.1	26	3.4	2.2
Fluoride, mg/l	1	0.9	18	14	20	15	20	14	17
Σ Cations, meq/l	11.50	9.09	13.90	11.79	14.37	11.93	14.12	11.47	11.63
Σ Anions, meq/l	11.05	9.87	13.53	11.54	13.85	11.74	13.74	12.66	11.48
% Difference	2.0	4.1	1.3	1.1	1.8	0.8	1.4	4.9	0.6
Silica, mg/l	27	24	14	13	12	13	13	11	13
pH	8.3	8.3	8.2	8.5	8.4	8.5	8.4	8.4	8.4
Calculated TDS, mg/l	681	581	747	633	759	638	748	656	617
Density at 22°C, g/ml		0.9983		0.9988		0.9984			0.9994

Table 2

MINOR CONSTITUENT ANALYSES
CORE HOLE AT 1-1A

Element	960 Feet Industrial	1344 Feet Industrial	1424 Feet Industrial	1620 Feet Industrial	1620 Ft C&L
Cyanite, mg/l	< 0.2	< 0.01	< 0.01	< 0.01	< 0.05
Phosphate, mg/l	< 0.1	0.3	< 0.1	< 0.1	0.06
Lithium, mg/l	0.6	< 0.5	< 0.5	< 0.5	0.03
Phenols, mg/l	< 0.003	< 0.001	< 0.001	< 0.001	< 0.05
BOD	1.0				
COD	9.4	19	16	17	
Sulfide, mg/l	< 0.1	< 0.1	< 0.1	< 0.1	
Ammonia, mg/l	1.9		1.6	2.2	0.8
Nitrite, mg/l	< 0.1	< 0.1	< 0.1	< 0.1	< 0.005
Nitrate, mg/l	0.46	< 0.1	< 0.1	< 0.1	0.32
Total Organic Carbon, mg/l					8
Oil and Grease					0.018
Color					7
Odor					1
Gross α pCi/l					5.9 ± 2.6
Radium 226 pCi/l					0.3 ± 0.5
Gross β pCi/l					7 ± 13

Gross α (incl. Ra 226) and gross β done by Hazen Research, Inc.

C & L LABORATORIES

Elemental Analysis — Mass Spectrometry

General Analytical Services

14335 West 44th Ave
Golden, Colo. 80401
(303) 278-9521

To: Mr. Frank Haas
The Oil Shale Corp.
18200 West Hiway 72
Golden, CO 80401

Date: 8-5-74

Analyst: S. Sweeney

C & L No.: 97-066-002-02

Customer No.:

Sample No.: Gulch Aquifer Test 1A 960'

CONCENTRATION IN PPM WEIGHT

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium		Terbium		Ruthenium		Vanadium	0.003
Thorium		Gadolinium		Molybdenum	0.09	Titanium	0.01
Bismuth		Europium		Niobium	0.008	Scandium	0.001
Lead	0.003	Samarium		Zirconium		Calcium	21
Thallium		Neodymium		Yttrium		Potassium	0.4
Mercury *	0.0005	Praseodymium		Strontium	1	Chlorine	3
Gold		Cerium		Rubidium	0.008	Sulfur	MC
Platinum		Lanthanum		Bromine	0.01	Phosphorus	0.02
Iridium		Barium	0.01	Selenium	0.002	Silicon	0.06
Osmium		Cesium		Arsenic	0.02	Aluminum	0.1
Rhenium		Iodine	0.001	Germanium	0.005	Magnesium	20
Tungsten	**	Tellurium		Gallium	0.001	Sodium	MC
Tantalum	**	Antimony		Zinc	0.03	Fluorine	0.6
Hafnium		Tin		Copper	0.01	Oxygen	NR
Lutetium		Indium	STD	Nickel	0.02	Nitrogen	NR
Ytterbium		Cadmium		Cobalt	0.007	Carbon	NR
Thulium		Silver		Iron	0.2	Boron	
Erbium		Palladium		Manganese	0.01	Beryllium	0.00006
Holmium		Rhodium		Chromium	0.007	Lithium	0.02
Dysprosium						Hydrogen	NR

NR - Not Reported <0.001 µg/ml *Flameless Atomic Absorption
All elements not reported
**Source Contamination

C & L LABORATORIES

Elemental Analysis — Mass Spectrometry

General Analytical Services

14335 West 44th Ave
Golden, Colo. 80401
(303) 278-9521

To: Mr. Frank Haas
The Oil Shale Corp.
18200 West Hiway 72
Golden, CO 80401

Date: 8-5-74

Analyst: S. Sweeney

C & L No.: 97-074-002-03

Customer No.:

Sample No.: TOSCO 1620' depth Aquifer Test #1.2, Bottom

CONCENTRATION IN PPM WEIGHT

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium		Terbium		Ruthenium		Vanadium	0.001
Thorium		Gadolinium		Molybdenum	0.05	Titanium	0.07
Bismuth		Europium		Niobium	0.002	Scandium	0.0003
Lead	0.003	Samarium		Zirconium		Calcium	*
Thallium		Neodymium		Yttrium		Potassium	*
Mercury	*	Praseodymium		Strontium	0.7	Chlorine	*
Gold		Cerium		Rubidium	0.008	Sulfur	*
Platinum		Lanthanum		Bromine	0.002	Phosphorus	*
Iridium		Barium	0.06	Selenium	0.004	Silicon	*
Osmium		Cesium	0.0009	Arsenic	0.008	Aluminum	2
Rhenium		Iodine		Germanium	0.005	Magnesium	6
Tungsten	**	Tellurium		Gallium	0.002	Sodium	*
Tantalum	**	Antimony		Zinc	0.09	Fluorine	*
Hafnium		Tin		Copper	0.02	Oxygen	NR
Lutetium		Indium	STD	Nickel	0.02	Nitrogen	NR
Ytterbium		Cadmium		Cobalt	0.007	Carbon	NR
Thulium		Silver		Iron	0.4	Boron	0.0002
Erbium		Palladium		Manganese	0.1	Beryllium	
Holmium		Rhodium		Chromium	0.007	Lithium	*
Dysprosium						Hydrogen	NR

NR - Not Reported

All elements not reported [illegible] <0.001 µg/ml

**Source Contamination

* Reported by different methods

THE INDUSTRIAL LABORATORIES COMPANY
Analytical and Consulting Chemists
2600 WEST 29TH AVENUE
DENVER, COLORADO 80211
TELEPHONE 455-3641

ANALYSIS REPORT

ATLANTIC RICHFIELD COMPANY

DATE RECEIVED:	6/21/74
DATE REPORTED:	6/27/74
LAB. NUMBER:	854

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SAMPLE MARKED: Arco 6/20/74 Sorghum Gulch Aqifer Test 1A
960 Feet

ANALYSIS:

		MILLIGRAMS PER LITER		MILLIGRAMS PER LITER
Calcium	0.85	17	Lithium	0.6
Magnesium	1.07	13	Barium	Less than 1.0
Sodium	9.57 11.50	220	Hexavalent chromium	Less than 0.01
Carbonate	1.33	37	Arsenic	Less than 0.05
Bicarbonate	5.25	320	Selenium	0.011
Chloride	0.68	24 4	Cadmium	Less than 0.01
Sulfate	3.85 11.01	185	Copper	Less than 0.1
Nitrate		0.46 ✓	Boron	2.4
Phosphate		Less than 0.1 ✓	Manganese	Less than 0.05
Silicon dioxide		27	Silver	Less than 0.01
Iron		Less than 0.05	Zinc	Less than 0.5
Fluoride		1.0	Mercury	Less than 0.01
P. alkalinity, in terms of calcium carbonate		30	Hydroxide	Less than 0.1
			Residual chlorine	Less than 0.1
MO alkalinity, in terms of calcium carbonate		260	Beryllium	Less than 0.1
Hardness, in terms of calcium carbonate		96	Molybdenum	Less than 0.1
			Lead	Less than 0.05
Total dissolved solids		780		
Ammonia-nitrogen		1.9		
Dissolved oxygen		5.8		
5-Day B.O.D.		1.0		
C.O.D.		9.4	pH	8.3
			Turbidity	3 units
MB-AS		Less than 0.5		
Phenols		Less than 0.003		
Cyanide		Less than 0.2		
Nitrite		Less than 0.1		
Sulfide		Less than 0.1		

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H. Paul
CHEMIST

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ANALYSIS REPORT

ATLANTIC RICHFIELD COMPANY

DATE RECEIVED: 7/3/74
DATE REPORTED: 8/1/74

LAB. NUMBER: 1155

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SAMPLE MARKED: Sorghum Gulch 1A 1,344 Feet Top

ANALYSIS:

	MILLIGRAMS PER LITER	MILLI-EQUIVALENTS	
Calcium	14	0.70	
Magnesium	7.1	0.58	
Sodium	290	12.73	12.6
Carbonate	25	0.83	
Bicarbonate	600	9.94	9.84
Chloride	20	0.52	.56
Sulfate	65	1.35	
Nitrate	Less than 0.1	----	
Phosphate	0.3	----	
Silicon dioxide	14	0.37	
Iron	Less than 0.05	----	
Fluoride	18	0.95	
P. alkalinity, in terms of calcium carbonate	20		
MO alkalinity, in terms of calcium carbonate	495		
Hardness, in terms of calcium carbonate	64		
Total dissolved solids	600		
C.O.D.	19		
MB-AS	Less than 0.5		
Phenols	Less than 0.001		
Cyanide	Less than 0.01		
Nitrite	Less than 0.1		
Sulfur	Less than 0.1		
Lithium	Less than 0.5		
Barium	Less than 1.0		
Hexavalent chromium	Less than 0.01		
Arsenic	Less than 0.01		
Selenium	Less than 0.01		

pH 8.2
Turbidity 4 units

	MILLIGRAMS PER LITER
Cadmium	Less than 0.01
Copper	Less than 0.1
Boron	0.6
Manganese	Less than 0.05
Silver	Less than 0.01
Zinc	Less than 0.5
Mercury	Less than 0.01
Hydroxide	Less than 0.1
Chlorine	Less than 0.1
Berlyium	Less than 0.1
Molybdenum	Less than 0.1
Lead	Less than 0.05

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ATLANTIC RICHFIELD COMPANY

DATE RECEIVED: 7/3/74
DATE REPORTED: 8/1/74

LAB. NUMBER: 1156

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SAMPLE MARKED: Sorghum Gulch 1A - 1,424 Feet Bottom

ANALYSIS:	MILLIGRAMS PER LITER	MILLI-EQUIVALENTS	
Calcium	11	0.55	
Magnesium	9.1	0.78	
Sodium	300	12.86	13.04
Carbonate	28	0.93	
Bicarbonate	610	10.00	
Chloride	28	0.79	
Sulfate	52	1.08	1.07
Nitrate	Less than 0.1	----	
Phosphate	Less than 0.1	----	
Silicon dioxide	12	0.32	
Iron	Less than 0.05	----	
Fluoride	20	1.05	

pH 8.4

Turbidity
1.0 units

P. alkalinity, in terms of calcium carbonate	23
MO alkalinity, in terms of calcium carbonate	500
Hardness, in terms of calcium carbonate	64
Total dissolved solids	640
Ammonia-nitrogen	1.6
C.O.D.	18
MB-AS	Less than 0.5
Phenols	Less than 0.001
Cyanide	Less than 0.01
Nitrite	Less than 0.1
Sulfur	Less than 0.1
Lithium	Less than 0.5
Barium	Less than 1.0
Hexavalent chromium	Less than 0.01
Arsenic	Less than 0.01
Selenium	Less than 0.01

	MILLIGRAMS PER LITER
Cadmium	Less than 0.01
Copper	Less than 0.1
Boron	4.1 ✓
Manganese	Less than 0.05
Silver	Less than 0.01
Zinc	Less than 0.5
Mercury	Less than 0.01
Hydroxide	Less than 0.1
Chlorine	Less than 0.1
Beryllium	Less than 0.1
Molybdenum	Less than 0.1
Lead	Less than 0.05

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DATE RECEIVED: 7/8/74
DATE REPORTED: 8/1/74

LAB. NUMBER: 1230

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SAMPLE MARKED: Sorghum Gulch Test 1A - Bottom 1,600 Feet

ANALYSIS:	MILLIGRAMS PER LITER	MILLI-EQUIVALENTS	
Calcium	9.8	0.49	
Magnesium	7.2	0.59	
Sodium	300	13.07	13.04
Carbonate	31	1.03	1.00
Bicarbonate	620	10.22	10.16
Chloride	26	0.73	
Sulfate	37	0.77	
Nitrate	Less than 0.1	----	
Phosphate	Less than 0.1	----	
Silicon dioxide	13	0.32	
Iron	Less than 0.05	----	
Fluoride	20	1.08	

pH 8.4

Turbidity 2 units

			MILLIGRAMS PER LITER
P. alkalinity, in terms of calcium carbonate	25		
MO alkalinity, in terms of calcium carbonate	510	Cadmium	Less than 0.01
Hardness, in terms of calcium carbonate	54	Copper	Less than 0.1
		Boron	Less than 0.1
		Manganese	Less than 0.05
Total dissolved solids	640	Silver	Less than 0.01
Ammonia-nitrogen	2.2	Zinc	Less than 0.5
C.O.D.	17		
MB-AS	Less than 0.5	Hydroxide	Less than 0.1
Phenols	Less than 0.001	Chlorine	Less than 0.1
		Beryllium	Less than 0.1
Cyanide	Less than 0.01	Molybdenum	Less than 0.1
Nitrite	Less than 0.1	Lead	Less than 0.05
Sulfur	Less than 0.1		
Lithium	Less than 0.5		
Barium	Less than 1.0		
Hexavalent chromium	Less than 0.01		
Arsenic	Less than 0.01		
Selenium	Less than 0.01		

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WATER QUALITY ANALYSES

AT - 1c

TRACT C-b

TABLE 1

MAJOR CONSTITUENT ANALYSES
CORE HOLE SGAT-1C, DST

Element, mg/1	1362 to 1512 feet		1515 to 1640 feet		1566 to 1640 feet (jetting water)		1566 to 1640 feet (D P water)
	Industrial	TOSCO	Industrial	TOSCO	Industrial	TOSCO	TOSCO
Sodium	260	240	300	324	310	330	318
Potassium	NA	2	NA	1.3	NA	0.6	0.7
Calcium	71	67	8.2	4.0	4.1	3.6	2.4
Magnesium	42	41	9.6	2.4	7.2	2.2	2.0
Sulfate	440	389	11	2.5	1.5	<2	2.5
Carbonate	<0.1	<0.1	30	24	21	36	27
Bicarbonate	480	520	730	705	750	729	744
Chloride	25	8	20	4	23	1	2
Fluoride	1.8	1.9	4.0	20	5.0	21	22
Σ Cations meq/1	18.31	17.20	14.24	14.52	14.28	14.73	14.13
Σ Anions meq/1	17.83	16.93	13.97	13.54	13.94	14.28	14.32
% Difference	1.8	0.8	1.0	3.5	1.2	1.6	0.7
Silica	22	16	11	15	11	13	14
pH	7.7	8.2	8.2	8.7	8.0	8.8	8.6
Calculated TDS	1,097	1,020	752	743	750	765	755

NA - Not Analyzed

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Analytical and Consulting Chemists

2600 WEST 29TH AVENUE
DENVER, COLORADO 80211
TELEPHONE 455-3641

ANALYSIS REPORT

ATLANTIC RICHFIELD COMPANY

DATE RECEIVED: 8/23/74
DATE REPORTED: 8/27/74

LAB. NUMBER: 2314

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SAMPLE MARKED: SG At #1C DST - 1,362 Feet

ANALYSIS:

	MILLIGRAMS PER LITER	MILLI-EQUIVALENTS	
Calcium	71	3.543	3.55
Magnesium	42	3.457	3.46
Sodium	260	11.308	11.30
Carbonate	Less than 0.1	------	
Bicarbonate	480	7.872	7.87
Chloride	25	0.705	.70
Sulfate	440	9.152	9.17
Nitrate	Less than 0.1	------	.09
Phosphate	Less than 0.1	------	
Silicon dioxide	22	0.579	

Σ cations = 18.3
Σ anions = 17.8
% D.H. = 1.8

Iron	Less than 0.05
Fluoride	1.8
P. alkalinity, in terms of calcium carbonate	Less than 0.1
MO alkalinity, in terms of calcium carbonate	390
Ammonia-nitrogen	0.4
Hardness, in terms of calcium carbonate	350
C.O.D.	11
MB-AS	Less than 0.5
Phenols	Less than 0.001
Cyanide	Less than 0.01
Hydrogen sulfide	Less than 0.1
Nitrite	0.3
Lithium	Less than 5
Barium	Less than 1
Hexavalent chromium	Less than 0.01

	MILLIGRAMS PER LITER
Arsenic	Less than 0.01
Selenium	Less than 0.01
Boron	1.3
Manganese	0.26
Mercury	Less than 0.01
Hydroxide	Less than 0.1
Total dissolved solids	990

pH 7.7
Turbidity 2 units

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ANALYSIS REPORT

ATLANTIC RICHFIELD COMPANY
2 Park Central, Suite 555
1515 Arapahoe Street
Denver, Colorado 80202
Attn: John Matis

DATE RECEIVED: 8/30/74
DATE REPORTED: 9/4/74

LAB. NUMBER: 2460

SAMPLES ARE DISCARDED IN 15 DAYS FROM DATE OF REPORT UNLESS WE ARE REQUESTED, IN WRITING, TO RETAIN THEM FOR A LONGER PERIOD. PERISHABLE SAMPLES ARE USUALLY DISCARDED IMMEDIATELY UNLESS CLIENT HAS REQUESTED SPECIAL HANDLING (FREEZING, ETC.) IN ADVANCE.

SAMPLE MARKED: SG 1-C DST Jetting 1515-1640 Feet

ANALYSIS:	MILLIGRAMS PER LITER	MILLI-EQUIVALENTS	
Calcium	8.2	0.409	0.41
Magnesium	9.6	0.790	.79
Sodium	300	12.772	13.24
Carbonate	30	0.999	1.00
Bicarbonate	730	11.890	11.97
Chloride	20	0.564	.56
Sulfate	11	0.229	0.23
Nitrate	Less than 0.1	-----	
Phosphate	Less than 0.1	-----	
Silicon dioxide	11	0.289	0.21
Iron	Less than 0.05		
Fluoride	4.0		
P. alkalinity, in terms of calcium carbonate	25		
MO alkalinity, in terms of calcium carbonate	600		
Hardness, in terms of calcium carbonate	60		
C.O.D.	35		
Phenols	Less than 0.001		
Cyanide	Less than 0.01		
Nitrite	Less than 0.1		
Sulfide	Less than 0.1		
Lithium	Less than 0.5		
Barium	Less than 1		
Hexavalent chromium	Less than 0.01		
Arsenic	Less than 0.01		
Selenium	Less than 0.01		

Σ cations = 14.24
Σ anions = 13.97
% D.R. - 1.0

	MILLIGRAMS PER LITER
Boron	0.35
Mercury	Less than 0.01
Hydroxide	Less than 0.1
Total dissolved solids	860
Cadmium	Less than 0.01
Copper	0.04
Lead	0.8
Manganese	0.07
Silver	0.014
Zinc	0.7

pH	8.2
Turbidity	12 units

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ANALYSIS REPORT

TELEPHONE 455-3641

ATLANTIC RICHFIELD COMPANY

DATE RECEIVED: 8/30/74
DATE REPORTED: 9/4/74

LAB. NUMBER: 2461

SAMPLES ARE DISCARDED IN 15 DAYS FROM DATE OF REPORT UNLESS WE ARE REQUESTED, IN WRITING, TO RETAIN THEM FOR A LONGER PERIOD. PERISHABLE SAMPLES ARE USUALLY DISCARDED IMMEDIATELY UNLESS CLIENT HAS REQUESTED SPECIAL HANDLING (FREEZING, ETC.) IN ADVANCE.

SAMPLE MARKED: SG-1-C DST 3 Jetting ~~1550~~ 1566-1640 Feet

ANALYSIS:	MILLIGRAMS PER LITER	MILLI-EQUIVALENTS	
Calcium	4.1	0.205	0.21
Magnesium	7.2	0.593	0.59
Sodium	310	13.222	13.48
Carbonate	21	0.699	0.70
Bicarbonate	750	12.382	12.30
Chloride	23	0.649	0.65
Sulfate	1.5	-----	.03
Nitrate	0.2	-----	
Phosphate	Less than 0.1	-----	
Silicon dioxide	11	0.289	0.26
Iron	Less than 0.05		
Ammonia-nitrogen	1.4		
Fluoride	5.0		
P. alkalinity, in terms of calcium carbonate	17		
MO alkalinity, in terms of calcium carbonate	620		
Hardness, in terms of calcium carbonate	40		
C.O.D.	165		
Phenols	Less than 0.001		
Cyanide	Less than 0.01		
Nitrite	Less than ~~GXX~~ 0.1		
Sulfide	Less than 0.1		
Lithium	Less than 0.5		
Barium	Less than 1		
Hexavalent chromium	Less than 0.01		
Arsenic	Less than 0.01		
Selenium	Less than 0.01		

Σ cations = 14.27
Σ anions = 13.94
% Diff = 1.2

	MILLIGRAMS PER LITER
Boron	0.25
Mercury	Less than 0.01
Hydroxide	Less than 0.1
Total dissolved solids	830
Cadmium	Less than 0.01
Copper	Less than 0.1
Lead	Less than 0.05
Manganese	Less than 0.05
Silver	Less than 0.01
Zinc	Less than 0.5

pH	8.0
Turbidity	6 units

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COMMERCIAL TESTING & ENGINEERING CO.
GENERAL OFFICES: 228 NORTH LA SALLE STREET, CHICAGO, ILLINOIS 60601 • AREA CODE 312 726-8434
Reply to INSTRUMENTAL ANALYSIS DIVISION, 14335 WEST AVENUE, GOLDEN, COLORADO, 80401, PHONE: 303-278-9521

To: Mr. Frank Haas
TOSCO
18200 West Hiway 72
Golden, CO 80401

Date: October 2, 1974

Analyst: S. Sweeney

P. O. No.:

Sample No.: SGAT #1C D.S.T. 1362-1512 ft.

IAD No.: 97-111-002-12

CONCENTRATION IN µg/ml

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium		Terbium		Ruthenium		Vanadium	
Thorium		Gadolinium		Molybdenum	0.02	Titanium	0.3
Bismuth		Europium		Niobium		Scandium	
Lead	0.5	Samarium		Zirconium		Calcium	*
Thallium		Neodymium		Yttrium		Potassium	*
Mercury **	0.0003	Praseodymium		Strontium	4	Chlorine	*
Gold		Cerium		Rubidium	0.005	Sulfur	*
Platinum		Lanthanum		Bromine		Phosphorus	0.2
Iridium		Barium	0.01	Selenium		Silicon	*
Osmium		Cesium		Arsenic		Aluminum	0.4
Rhenium		Iodine		Germanium		Magnesium	*
Tungsten		Tellurium		Gallium		Sodium	*
Tantalum		Antimony		Zinc	0.8	Fluorine	*
Hafnium		Tin		Copper	0.05	Oxygen	NR
Lutetium		Indium	STD	Nickel	0.01	Nitrogen	NR
Ytterbium		Cadmium		Cobalt	0.004	Carbon	NR
Thulium		Silver		Iron	0.8	Boron	0.02
Erbium		Palladium		Manganese	0.1	Beryllium	0.001
Holmium		Rhodium		Chromium		Lithium	0.2
Dysprosium						Hydrogen	NR

NR — Not Reported
All elements not reported <0.009 µg/ml
**Flameless Atomic Absorption

*Not reported upon request

Approved: M J Jacobs

COMMERCIAL TESTING & ENGINEERING CO.
GENERAL OFFICES: 228 NORTH LA SALLE STREET, CHICAGO, ILLINOIS 60601 • AREA CODE 312 726-8434
Reply to INSTRUMENTAL ANALYSIS DIVISION, 14335 WEST AVENUE, GOLDEN, COLORADO, 80401, PHONE: 303-278-9521

To: Mr. Frank Haas
TOSCO
18200 West Hiway 72
Golden, CO 80401

Date: October 2, 1974

Analyst: S. Sweeney

P. O. No.:

Sample No.: SGAT #1C D.S.T. 1515'-1640 ft.

IAD No.: 97-111-002-12

CONCENTRATION IN ~~PPM WEIGHT~~ μg/ml

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium		Terbium		Ruthenium		Vanadium	0.003
Thorium		Gadolinium		Molybdenum	0.03	Titanium	0.06
Bismuth		Europium		Niobium		Scandium	0.002
Lead	0.4	Samarium		Zirconium		Calcium	*
Thallium		Neodymium		Yttrium		Potassium	*
Mercury **	[illegible]	Praseodymium		Strontium	0.3	Chlorine	*
Gold		Cerium	0.005	Rubidium	0.02	Sulfur	*
Platinum		Lanthanum	0.009	Bromine	0.01	Phosphorus	0.4
Iridium		Barium	0.09	Selenium		Silicon	*
Osmium		Cesium		Arsenic	0.02	Aluminum	10
Rhenium		Iodine		Germanium	0.006	Magnesium	*
Tungsten		Tellurium		Gallium	0.006	Sodium	*
Tantalum		Antimony		Zinc	0.2	Fluorine	*
Hafnium		Tin		Copper	0.01	Oxygen	NR
Lutetium		Indium	STD	Nickel	0.008	Nitrogen	NR
Ytterbium		Cadmium		Cobalt	0.004	Carbon	NR
Thulium		Silver		Iron	3	Boron	0.03
Erbium		Palladium		Manganese	0.2	Beryllium	
Holmium		Rhodium		Chromium	0.02	Lithium	0.4
Dysprosium						Hydrogen	NR

NR — Not Reported
All elements not reported [illegible] <0.006 μg/ml
**Flameless Atomic Absorption

*Not reported upon request

Approved: M. J. Jacobs

COMMERCIAL TESTING & ENGINEERING CO.
GENERAL OFFICES: 228 NORTH LA SALLE STREET, CHICAGO, ILLINOIS 60601 • AREA CODE 312 726-8434
Reply to INSTRUMENTAL ANALYSIS DIVISION, 14335 WEST AVENUE, GOLDEN, COLORADO, 80401, PHONE: 303 278-9521

To: Mr. Frank Haas
TOSCO
18200 West Hiway 72
Golden, CO 80401

Date: October 2, 1974

Analyst: S. Sweeney

P. O. No.:

Sample No.: SGAT #1C D.S.T. 1566-1640 ft.

IAD No.: 97-111-002-12

CONCENTRATION IN ~~PPM WEIGHT~~ µg/ml

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium		Terbium		Ruthenium		Vanadium	≤0.001
Thorium		Gadolinium		Molybdenum	**0.01	Titanium	0.05
Bismuth		Europium		Niobium		Scandium	≤0.001
Lead	0.04	Samarium		Zirconium		Calcium	*
Thallium		Neodymium		Yttrium		Potassium	*
Mercury***	0.0004	Praseodymium		Strontium	0.4	Chlorine	*
Gold		Cerium	0.003	Rubidium	0.002	Sulfur	*
Platinum		Lanthanum	0.003	Bromine	0.007	Phosphorus	0.06
Iridium		Barium	0.06	Selenium		Silicon	*
Osmium		Cesium	0.003	Arsenic		Aluminum	2
Rhenium		Iodine		Germanium		Magnesium	*
Tungsten		Tellurium		Gallium	x.5 [illegible] or <.5	Sodium	*
Tantalum		Antimony		Zinc	3	Fluorine	*
Hafnium		Tin		Copper	0.03	Oxygen	NR
Lutetium		Indium	STD	Nickel	0.004	Nitrogen	NR
Ytterbium		Cadmium		Cobalt	0.01	Carbon	NR
Thulium		Silver		Iron	0.08	Boron	0.05
Erbium		Palladium		Manganese	0.03	Beryllium	
Holmium		Rhodium		Chromium	0.002	Lithium	0.07
Dysprosium						Hydrogen	NR

NR – Not Reported
All elements not reported <0.004 µg/ml <0.1 ppm weight
*Not Reported upon request
**Heterogeneous
***Flameless Atomic Absorption

Approved: MJ Jacobs

COMMERCIAL TESTING & ENGINEERING CO.
GENERAL OFFICES: 228 NORTH LA SALLE STREET, CHICAGO, ILLINOIS 60601 • AREA CODE 312 726-8434
Reply to INSTRUMENTAL ANALYSIS DIVISION, 14335 WEST AVENUE, GOLDEN, COLORADO, 80401, PHONE: 303-278-9521

To: Mr. Frank Haas
TOSCO
18200 West Hiway 72
Golden, CO 80401

Date: October 2, 1974

Analyst: S. Sweeney

P. O. No.:

Sample No.: SGAT #1C D.S.T. 1566-1640 ft.

IAD No.: 97-111-002-12

CONCENTRATION IN ~~ppm~~ µg/ml WEIGHT

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium		Terbium		Ruthenium		Vanadium	≤0.001
Thorium		Gadolinium		Molybdenum	0.009	Titanium	0.01
Bismuth		Europium		Niobium		Scandium	≤0.001
Lead	0.1	Samarium		Zirconium		Calcium	*
Thallium		Neodymium		Yttrium		Potassium	*
Mercury **	0.0007	Praseodymium		Strontium	0.1	Chlorine	*
Gold		Cerium	0.002	Rubidium	0.003	Sulfur	*
Platinum		Lanthanum	0.003	Bromine	0.01	Phosphorus	0.1
Iridium		Barium	0.04	Selenium		Silicon	*
Osmium		Cesium		Arsenic	0.006	Aluminum	0.3
Rhenium		Iodine		Germanium		Magnesium	*
Tungsten		Tellurium		Gallium		Sodium	*
Tantalum		Antimony		Zinc	0.6	Fluorine	*
Hafnium		Tin		Copper	0.03	Oxygen	NR
Lutetium		Indium	STD	Nickel	0.002	Nitrogen	NR
Ytterbium		Cadmium		Cobalt		Carbon	NR
Thulium		Silver		Iron	0.5	Boron	0.008
Erbium		Palladium		Manganese	0.01	Beryllium	
Holmium		Rhodium		Chromium	0.007	Lithium	0.04
Dysprosium						Hydrogen	NR

NR – Not Reported
All elements not reported <0.002 µg/ml ~~<0.1 ppm weight~~
**Flameless Atomic Absorption

*Not reported upon request

Approved: M J Jacobs

CABLE ADDRESS COMTECO

COMMERCIAL TESTING & ENGINEERING CO.

GENERAL OFFICES: 228 NORTH LA SALLE STREET, CHICAGO, ILLINOIS 60601 · AREA CODE 312 726-8434

SINCE 1908

Reply to
Instrumental Analysis Division
14335 West 44th Avenue
Golden, Colorado 80401

Phone: 303-278-9521

October 2, 1974

Mr. Frank Haas
TOSCO
18200 West Hiway 72
Golden, CO 80401

ANALYTICAL REPORT

MG/LITER TOC:

SG-Cb-2B Top Para Cr. 890 ft.	-.1
✓ SGAT #1C D.S.T. 1362-1512 ft.	-.1
✓ SGAT #1C D.S.T. 1515'-1640 ft.	-.1
✓ SGAT #1C D.S.T. 1566-1640 ft.	-.1
✓ SGAT #1C D.S.T. 1566-1640 ft.	-.1
SG #11 1330 ft.	-.1
SG #11 1385 ft.	-.1
SG #11 Depth 2465	-.1
SG #11 2825 ft.	-.1
SG #6 1350 ft. Top of Mining Zone	-.1
SG #6 1425 ft. Bottom of Mining Zone	-.1
SG #6 1547 ft. Below "B" Groove	-.1

Minus sign indicates parameter is below level indicated.
TOC was run on waters marked "Regular".

Sincerely,

M L Jacobs

M. L. Jacobs

MLJ/hb

RECEIVED
OCT 15 1974
IOSCO-GOLDEN

HAZEN RESEARCH, INC.
4601 Indiana Street
Golden, Colorado 80401

Mr. Frank Haas
The Oil Shale Corporation
18200 West Highway 72
Golden, Colorado 80401

Date: September 27, 1974
HRI Project No. 535
HRI Series No. 7371
Samples received: Sept. 13, 1974

REPORT OF ANALYSIS

Analysis No.	Sample Designation	α Total (pCi/l)	±	α Precision*	β Total (pCi/l)	±	β Precision*
7371-1 ✓	S.G. A.T. #1 C Dst 1362-1512'	24	±	5	4	±	12
-2 ✓	S.G. A.T. #2 Reg. Dst 1566-1640'	4.7	±	3.1	9	±	12
-3	S.G. Cb-2B Top Para Ct. 890'	5.5	±	3.0	15	±	12
-4 ✓	S.G. A.T. 1C Dst #3 Reg.1566-1640'	3.6	±	2.8	14	±	12
-5	S.G. #6 1350' Top of mining zone	5.3	±	3.1	12	±	12
-6	S.G. #6 Below B Groove 1547'	5.4	±	3.2	12	±	12
-7	S.G. #6 Bottom of mining zone 1425'	4.5	±	2.7	6	±	12
-8	S.G. #11 1330'	3.4	±	2.8	0	±	13
-9	S.G. 1385'	7.1	±	2.9	3	±	12
-10	S.G. #11 Depth 2465 Top G.G.	4.5	±	3.0	0	±	19
-11	S.G. #11 2825'	2.8	±	2.1	0	±	12
-12 ✓	S.G. A.T. 1C Dst-DS water 1515-1640'	8.6	±	2.8	0	±	11

By: John C. Jarvis
John C. Jarvis
Manager, Analytical Laboratory

ljb

*Variability of the radioactive disintegration process (counting error) at the 95% confidence level, 1.96σ

HAZEN RESEARCH, INC.
4601 Indiana Street
Golden, Colorado 80401

Mr. Frank Haas
The Oil Shale Corporation
18200 West Highway 72
Golden, Colorado 80401

Date: October 14, 1974
HRI Project No. 535
HRI Series No. 7371
Samples received: Sept. 13, 1974

Page 2

REPORT OF ANALYSIS

Analysis No.	Sample Designation	Ra^{226} (pCi/l)	±	Precision*
7371-1 ✓	S.G. A.T. 1C DST 1362-1512 ft.	0	±	0.5
-2 ✓	S.G. A.T. 1C Req. DST 1566-1640 ft.	0.2	±	0.7
-3	S.G. Cb-2B Top Para Ct. 890 ft.	0	±	0.5
-4 ✓	S.G. A.T. 1C DST #3 Reg. 1566-1640 ft.	0.1	±	0.6
-5	S.G. #6 1350 ft. Top of Mining Zone	0	±	0.6
-6	S.G. #6 Below "B" Groove 1547 ft.	0.2	±	0.7
-7	S.G. #6 Bottom of Mining Zone 1425 ft.	0.1	±	0.6
-8	S.G. #11 1330 ft.	0.1	±	0.6
-9	S.G. 1385 ft.	0	±	0.5
-10	S.G. #11 Depth 2465 Top G.G.	0.2	±	0.6
-11	S.G. #11 2825 ft.	0	±	0.5
-12 ✓	S.G. A.T. 1C dist. DS Water 1515-1640 ft.	0.7	±	0.7

*Variability of the radioactive disintegration process (counting error) at the 95% confidence level, 1.96σ

By: John C. Jarvis
John C. Jarvis
Manager, Analytical Laboratory

ljb

WATER QUALITY ANALYSES

SG - 6

TRACT C-b

TABLE 1

MAJOR CONSTITUENT ANALYSES
CORE HOLE SG-6

	910 ft.	1350 ft.		1425 ft.		1547 ft.		2220 ft.
Element, mg/1	Industrial	Industrial	TOSCO	Industrial	TOSCO	Industrial	TOSCO	Industrial
Sodium	195	305	298	330	308	330	302	330
Potassium	NA	NA	1.3	NA	1.3	NA	1.7	NA
Calcium	25	12	8	7.4	5.1	7.4	4.3	7.4
Magnesium	19	7.1	7.3	4.3	4.5	2.8	3.8	6.2
Sulfate	160	37	32	< 4	4	< 4	4	13
Carbonate	30	<0.1	24	45	25	33	23	48
Bicarbonate	360	760	739	740	751	750	769	760
Chloride	19	19	5	27	2	24	3	13
Fluoride	4.2	18	13	20	19	20	19	4.5
Σ Cations meq/1	11.29	14.44	14.00	15.07	14.05	14.95	13.70	15.23
Σ Anions meq/1	10.99	14.72	14.40	15.44	14.28	15.13	14.54	14.94
% Difference	1.3	1.0	1.4	1.2	0.8	0.6	2.9	1.0
Silica	21	14	13	13	13	16	13	11
pH	8.8	7.4	8.5	8.3	8.5	8.3	8.6	8.3
Calculated TDS	650	751	764	809	750	800	728	806

NA - Not Applicable

THE INDUSTRIAL LABORATORIES COMPANY
Analytical and Consulting Chemists
2600 WEST 29TH AVENUE
DENVER, COLORADO 80211
TELEPHONE 455-3641

ANALYSIS REPORT

DATE RECEIVED:	8/9/74
DATE REPORTED:	8/22/74
LAB. NUMBER:	2014

ATLANTIC RICHFIELD COMPANY
2 Park Central, Suite 555
1515 Arapahoe Street
Denver, Colorado 80202
Attn: John Matis

SAMPLES ARE DISCARDED IN 15 DAYS FROM DATE OF REPORT UNLESS WE ARE REQUESTED, IN WRITING, TO RETAIN THEM FOR A LONGER PERIOD. PERISHABLE SAMPLES ARE USUALLY DISCARDED IMMEDIATELY UNLESS CLIENT HAS REQUESTED SPECIAL HANDLING (FREEZING, ETC.) IN ADVANCE.

SAMPLE MARKED: S.G. #6 - Top of Parachute Creek 910 Feet

ANALYSIS:

	MILLIGRAMS PER LITER			MILLI-EQUIVALENTS
Calcium	25		1.25	1.247
Magnesium	19		1.56	1.564
Sodium	195	Σ cations = 11.29	8.48	8.508
Carbonate	30	Σ anions = 10.97	1.00	0.999
Bicarbonate	360	% diff = 1.3	5.90	5.904
Chloride	19		0.54	0.536
Sulfate	160		3.33	3.328
Nitrate	4.6		0.22	-----
Phosphate	Less than 0.1			-----
Silicon dioxide	21			0.552
Iron	Less than 0.05			
Fluoride	4.2			
P. alkalinity, in terms of calcium carbonate	25			
MO alkalinity, in terms of calcium carbonate	300			
Hardness, in terms of calcium carbonate	140			
Total dissolved solids	605			
MB-AS	Less than 0.5			
Phenols	Less than 0.001			
Cyanide	Less than 0.01			
Nitrite	Less than 0.1			
Sulfur	Less than 0.1			
Lithium	Less than 1.0			
Barium	Less than 1.0			
Hexavalent chromium	Less than 0.01			
Arsenic	Less than 0.01			

pH 8.8

Turbidity
Less than
1 unit

	MILLIGRAMS PER LITER
Selenium	Less than 0.01
Boron	2.5
Mercury	Less than 0.01
Cadmium	Less than 0.01
Copper	Less than 0.1
Lead	Less than 0.05
Molybdenum	Less than 0.05
Silver	Less than 0.01
Zinc	Less than 0.05
Cobalt	Less than 0.1

THE INDUSTRIAL LABORATORIES COMPANY
J. Paul Schad
CHEMIST

MEMBERS OF:
AMERICAN ASS'N OF CEREAL CHEMISTS
AMERICAN CHEMICAL SOCIETY
AMERICAN OIL CHEMISTS' SOCIETY
ASS'N OF OFFICIAL RACING CHEMISTS
[illegible] ENGINEERS OF AMERICA
INSTITUTE OF FOOD TECHNOLOGY
SIGMA XI

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THE INDUSTRIAL LABORATORIES COMPANY

Analytical and Consulting Chemists

2600 WEST 29TH AVENUE
DENVER, COLORADO 80211
ANALYSIS REPORT

TELEPHONE 455-3641

ATLANTIC RICHFIELD COMPANY
2 Park Central, Suite 555
1515 Arapahoe Street
Denver, Colorado 80202
Attn: John Matis

DATE RECEIVED: 8/23/74
DATE REPORTED: 8/27/74

LAB. NUMBER: 2309

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SAMPLE MARKED: S.G. #6 - Top 1,350 Feet

ANALYSIS:	MILLIGRAMS PER LITER		MILLI-EQUIVALENTS	
Calcium (Ca)	12		0.599	0.60
Magnesium (Mg)	7.1		0.584	0.58
Sodium (Na)	305		13.245	13.24
Carbonate (CO_3)	Less than 0.1		----	
Bicarbonate (HCO_3)	760		12.464	12.46
Chloride (Cl)	19		0.536	0.54
Sulfate (SO_4)	37		0.770	.77
Nitrate (NO_3)	Less than 0.1		----	Σ cations = 14.44
Phosphate (PO_4)	Less than 0.1		----	Σ anions = 14.72
Silicon dioxide (SiO_2)	14		0.368	[illegible] = 1.0
Iron (Fe)	Less than 0.05	0.95	----	
Fluoride (F)	18		0.290	
P. alkalinity, in terms of calcium carbonate	Less than 0.1			
MO alkalinity, in terms of calcium carbonate	620			
Hardness, in terms of calcium carbonate	60			
C.O.D.	27			
MB-AS	Less than 0.5			
Phenols	Less than 0.001			
Cyanide (Cn)	Less than 0.01			
Hydrogen sulfide (H_2S)	Less than 0.1			
Nitrite (NO_2)	Less than 0.1			
Lithium (Li)	Less than 5			
Barium (Ba)	Less than 1			
Hexavalent chromium	Less than 0.01			
Arsenic (As)	0.04			

	MILLIGRAMS PER LITER
Selenium (Se)	Less than 0.01
Boron (B)	1.2
Manganese (Mn)	Less than 0.05
Mercury (Hg)	Less than 0.01
Hydroxide (OH)	Less than 0.1
Total dissolved solids	750
Ammonia-nitrogen	0.3

pH	7.4
Turbidity	1 unit

MEMBERS OF:
AMERICAN ASS'N OF CEREAL CHEMISTS
AMERICAN CHEMICAL SOCIETY
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SIGMA XI

THE INDUSTRIAL LABORATORIES COMPANY
H. Paul Ochs
CHEMIST

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THE INDUSTRIAL LABORATORIES COMPANY

Analytical and Consulting Chemists

2600 WEST 29TH AVENUE
DENVER, COLORADO 80211
TELEPHONE 455-3641

ANALYSIS REPORT

ATLANTIC RICHFIELD

DATE RECEIVED: 8/23/74
DATE REPORTED: 8/27/74

LAB. NUMBER: 2311

SAMPLES ARE DISCARDED IN 15 DAYS FROM DATE OF REPORT UNLESS WE ARE REQUESTED, IN WRITING, TO RETAIN THEM FOR A LONGER PERIOD. PERISHABLE SAMPLES ARE USUALLY DISCARDED IMMEDIATELY UNLESS CLIENT HAS REQUESTED SPECIAL HANDLING (FREEZING, ETC.) IN ADVANCE.

SAMPLE MARKED: SG #6 - Bottom 1,425 Feet

ANALYSIS:

	MILLIGRAMS PER LITER	MILLI-EQUIVALENTS	
Calcium	7.4	0.369	0.37
Magnesium	4.3	0.354	0.35
Sodium	330	14.337	14.35
Carbonate	45	1.499	1.50
Bicarbonate	740	12.136	12.13
Chloride	27	0.761	0.76
Sulfate	Less than 4	-----	
Nitrate	Less than 0.1	-----	Σ cations : 15.07
Phosphate	Less than 0.1	-----	Σ anions : 15.44
Silicon dioxide	13	0.342	% diff. : 1.2
Iron	Less than 0.05	-----	
Fluoride	20 → 1.05	0.322	
P. alkalinity, in terms of calcium carbonate	37	-----	
MO alkalinity, in terms of calcium carbonate	610		
Hardness, in terms of calcium carbonate	36		
Ammonia-nitrogen	Less than 0.1		
C.O.D.	7.0		
MB-AS	Less than 0.5		
Phenols	Less than 0.001		
Cyanide	Less than 0.01		
Hydrogen sulfide	Less than 0.1		
Nitrite	Less than 0.1		
Lithium	Less than 5		
Barium	Less than 1		
Hexavalent chromium	Less than 0.01		

	MILLIGRAMS PER LITER
Arsenic	0.01
Selenium	Less than 0.01
Boron	1.2
Manganese	Less than 0.05
Mercury	Less than 0.01
Hydroxide	Less than 0.1
Total dissolved solids	760

pH	8.3
Turbidity	2 units

MEMBERS OF:

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AMERICAN CHEMICAL SOCIETY
AMERICAN OIL CHEMISTS' SOCIETY
ASS'N OF OFFICIAL RACING CHEMISTS
[illegible] OF AMERICA
INSTITUTE OF FOOD TECHNOLOGY
SIGMA XI

THE INDUSTRIAL LABORATORIES COMPANY

H. Paul Vela

CHEMIST

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THE INDUSTRIAL LABORATORIES COMPANY

Analytical and Consulting Chemists

2600 WEST 29TH AVENUE
DENVER, COLORADO 80211

TELEPHONE 455-3641

ANALYSIS REPORT

DATE RECEIVED: 8/23/74
DATE REPORTED: 8/27/74

LAB. NUMBER: 2310

ATLANTIC RICHFIELD COMPANY

SAMPLES ARE DISCARDED IN 15 DAYS FROM DATE OF REPORT UNLESS WE ARE REQUESTED, IN WRITING, TO RETAIN THEM FOR A LONGER PERIOD. PERISHABLE SAMPLES ARE USUALLY DISCARDED IMMEDIATELY UNLESS CLIENT HAS REQUESTED SPECIAL HANDLING (FREEZING, ETC.) IN ADVANCE.

SAMPLE MARKED: SG #6 - Below "B" 1547 Feet

ANALYSIS:

	MILLIGRAMS PER LITER		MILLI-EQUIVALENTS	
Calcium	7.4		0.369	0.37
Magnesium	2.8		0.230	0.23
Sodium	330		14.220	14.35
Carbonate	33		1.099	1.10
Bicarbonate	750		12.300	12.30
Chloride	24		0.677	0.63
Sulfate	Less than 4		-----	
Nitrate	Less than 0.1		-----	Σ cations - 14.95
Phosphate	Less than 0.1		-----	Σ anions - 15.13
Silicon dioxide	16		0.421	% Diff. 0.6
Iron	Less than 0.05		-----	
Fluoride	20	→ 1.65	0.322	
Ammonia-nitrogen	0.3			
P. alkalinity, in terms of calcium carbonate	27			
MO alkalinity, in terms of calcium carbonate	620			
Hardness, in terms of calcium carbonate	30			
C.O.D.	8.3			
MB-AS	Less than 0.5			
Phenols	Less than 0.01			
Cyanide	Less than 0.01			
Hydrogen sulfide	Less than 0.1			
Nitrite	0.2			
Lithium	Less than 5			
Barium	Less than 1			
Hexavalent chromium	Less than 0.01			

	MILLIGRAMS PER LITER
Arsenic	0.02
Selenium	Less than 0.01
Boron	Less than 0.5
Manganese	Less than 0.05
Mercury	Less than 0.01
Hydroxide	Less than 0.1
Total dissolved solids	775

pH 8.3
Turbidity 2 units

THE INDUSTRIAL LABORATORIES COMPANY

CHEMIST

MEMBERS OF:

AMERICAN ASSN OF CEREAL CHEMISTS
AMERICAN CHEMICAL SOCIETY
AMERICAN OIL CHEMISTS' SOCIETY
ASSN OF OFFICIAL RACING CHEMISTS
[illegible]
INSTITUTE OF FOOD TECHNOLOGY
SIGMA XI

THIS REPORT IS NOT TO BE REPRODUCED, IN WHOLE OR IN PART, FOR ADVERTISING PURPOSES WITHOUT OBTAINING PRIOR WRITTEN AUTHORIZATION

THE INDUSTRIAL LABORATORIES COMPANY
Analytical and Consulting Chemists
2600 WEST 29TH AVENUE
DENVER, COLORADO 80211
TELEPHONE 455-3641

ANALYSIS REPORT

ATLANTIC RICHFIELD COMPANY

DATE RECEIVED: 8/30/74
DATE REPORTED: 9/4/74

LAB. NUMBER: 2462

SAMPLES ARE DISCARDED IN 15 DAYS FROM DATE OF REPORT UNLESS WE ARE REQUESTED, IN WRITING, TO RETAIN THEM FOR A LONGER PERIOD. PERISHABLE SAMPLES ARE USUALLY DISCARDED IMMEDIATELY UNLESS CLIENT HAS REQUESTED SPECIAL HANDLING (FREEZING, ETC.) IN ADVANCE.

SAMPLE MARKED: SG #6 T.D. 2220 Feet

ANALYSIS:

	MILLIGRAMS PER LITER	MILLI-EQUIVALENTS	
Calcium	7.4	0.369	0.37
Magnesium	6.2	0.510	0.51
Sodium	330	14.109	14.35
Carbonate	48	1.598	1.60
Bicarbonate	760	12.464	[illegible]
Chloride	13	0.367	0.37
Sulfate	13	0.270	0.27
Nitrate	0.2	-----	
Phosphate	Less than 0.1	-----	Σ cations = 15.23
Silicon dioxide	11	0.289	Σ anions = 14.94
			[illegible] = 1.0

0.24

			MILLIGRAMS PER LITER
Iron	Less than 0.05		
Ammonia-nitrogen	0.8		
Fluoride	4.5	Selenium	Less than 0.01
P. alkalinity, in terms of calcium carbonate	39	Boron Mercury	Less than 0.1 Less than 0.01
MO alkalinity, in terms of calcium carbonate	630	Hydroxide Total dissolved solids	Less than 0.1 890
Hardness, in terms of calcium carbonate	44	Cadmium	Less than 0.01
C.O.D.	5.0	Copper	Less than 0.1
Phenols	Less than 0.001	Lead	Less than 0.05
Cyanide	Less than 0.01	Manganese	Less than 0.05
Nitrite	Less than 0.1	Silver	0.012
		Zinc	Less than 0.5
Sulfide	Less than 0.1		
Lithium	Less than 0.5		
Barium	Less than 1.0		
Hexavalent chromium	Less than 0.01	pH	8.3
Arsenic	Less than 0.01	Turbidity	Less than 1 unit

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SIGMA XI

THE INDUSTRIAL LABORATORIES COMPANY

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COMMERCIAL TESTING & ENGINEERING CO.
GENERAL OFFICES: 228 NORTH LA SALLE STREET, CHICAGO, ILLINOIS 60601 · AREA CODE 312 726-8434
Reply to INSTRUMENTAL ANALYSIS DIVISION, 14335 WEST AVENUE, GOLDEN, COLORADO, 80401, PHONE: 303-278-9521

To: Mr. Frank Haas
TOSCO
18200 West Hiway 72
Golden, CO 80401

Date: October 2, 1974

Analyst: S. Sweeney

P. O. No.:

Sample No.: SG #6 1350 ft. Top of Mining Zone

IAD No.: 97-111-002-12

CONCENTRATION IN ~~PPM WEIGHT~~ μg/ml

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium		Terbium		Ruthenium		Vanadium	<0.001
Thorium		Gadolinium		Molybdenum	0.05	Titanium	0.01
Bismuth		Europium		Niobium		Scandium	
Lead	0.009	Samarium		Zirconium		Calcium	*
Thallium		Neodymium		Yttrium		Potassium	*
Mercury **	0.0009	Praseodymium		Strontium	0.4	Chlorine	*
Gold		Cerium		Rubidium	0.004	Sulfur	*
Platinum		Lanthanum		Bromine	0.007	Phosphorus	0.05
Iridium		Barium	0.03	Selenium		Silicon	*
Osmium		Cesium		Arsenic	0.01	Aluminum	0.3
Rhenium		Iodine		Germanium		Magnesium	*
Tungsten		Tellurium		Gallium		Sodium	*
Tantalum		Antimony		Zinc	0.06	Fluorine	*
Hafnium		Tin /		Copper	0.01	Oxygen	NR
Lutetium		Indium	STD	Nickel	0.008	Nitrogen	NR
Ytterbium		Cadmium		Cobalt	0.003	Carbon	NR
Thulium		Silver		Iron	0.06	Boron	0.05
Erbium		Palladium		Manganese	0.009	Beryllium	
Holmium		Rhodium		Chromium	0.003	Lithium	0.04
Dysprosium						Hydrogen	NR

NR -- Not Reported <0.002 μg/ml *Not reported upon request
All elements not reported ~~XXX ppm weight~~
**Flameless Atomic Absorption

Approved:

COMMERCIAL TESTING & ENGINEERING CO.
GENERAL OFFICES: 228 NORTH LA SALLE STREET, CHICAGO, ILLINOIS 60601 • AREA CODE 312 726-8434
Reply to INSTRUMENTAL ANALYSIS DIVISION, 14335 WEST AVENUE, GOLDEN, COLORADO, 80401, PHONE: 303-278-9521

To: Mr. Frank Haas
TOSCO
18200 West Hiway 72
Golden, CO 80401

Date: October 2, 1974

Analyst: S. Sweeney

P. O. No.:

Sample No.: SG #6 1425 ft. Bottom of Mining Zone

IAD No.: 97-111-002-12

CONCENTRATION IN ~~PPM WEIGHT~~ μg/ml

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium		Terbium		Ruthenium		Vanadium	≤0.001
Thorium		Gadolinium		Molybdenum	0.02	Titanium	0.01
Bismuth		Europium		Niobium		Scandium	≤0.001
Lead	0.01	Samarium		Zirconium		Calcium	*
Thallium		Neodymium		Yttrium	≤0.001	Potassium	*
Mercury **	0.0008	Praseodymium		Strontium	0.3	Chlorine	*
Gold		Cerium		Rubidium	0.006	Sulfur	*
Platinum		Lanthanum	0.002	Bromine	0.005	Phosphorus	0.04
Iridium		Barium	0.03	Selenium		Silicon	*
Osmium		Cesium	0.003	Arsenic	0.01	Aluminum	0.3
Rhenium		Iodine		Germanium		Magnesium	*
Tungsten		Tellurium		Gallium		Sodium	*
Tantalum		Antimony		Zinc	0.06	Fluorine	*
Hafnium		Tin		Copper	0.02	Oxygen	NR
Lutetium		Indium	STD	Nickel	0.01	Nitrogen	NR
Ytterbium		Cadmium		Cobalt	0.003	Carbon	NR
Thulium		Silver		Iron	0.2	Boron	0.03
Erbium		Palladium		Manganese	0.01	Beryllium	
Holmium		Rhodium		Chromium	0.01	Lithium	0.3
Dysprosium						Hydrogen	NR

NR -- Not Reported <0.002 μg/ml *Not reported upon request
All elements not reported ~~[illegible] weight~~
**Flameless Atomic Absorption

Approved: M J Jacobs

COMMERCIAL TESTING & ENGINEERING CO.
GENERAL OFFICES: 220 NORTH LA SALLE STREET, CHICAGO, ILLINOIS 60601 · AREA CODE 312 726-8434
Reply to INSTRUMENTAL ANALYSIS DIVISION, 14335 WEST AVENUE, GOLDEN, COLORADO, 80401, PHONE: 303-278-9521

To: Mr. Frank Haas
TOSCO
18200 West Hiway 72
Golden, CO 80401

Date: October 2, 1974

Analyst: S. Sweeney

P. O. No.:

Sample No.: SG #6 1547 ft. Below "B" Groove

IAD No.: 97-111-002-12

CONCENTRATION IN ~~BY WEIGHT~~ µg/ml

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium		Terbium		Ruthenium		Vanadium	
Thorium		Gadolinium		Molybdenum	0.03	Titanium	0.01
Bismuth		Europium		Niobium		Scandium	
Lead		Samarium		Zirconium		Calcium	*
Thallium		Neodymium		Yttrium		Potassium	*
Mercury **	0.0006	Praseodymium		Strontium	0.3	Chlorine	*
Gold		Cerium	0.003	Rubidium	0.009	Sulfur	*
Platinum		Lanthanum	0.003	Bromine	0.01	Phosphorus	0.2
Iridium		Barium	0.08	Selenium		Silicon	*
Osmium		Cesium	0.004	Arsenic	0.03	Aluminum	0.2
Rhenium		Iodine		Germanium		Magnesium	*
Tungsten		Tellurium		Gallium		Sodium	*
Tantalum		Antimony		Zinc	0.1	Fluorine	*
Hafnium		Tin		Copper	0.03	Oxygen	NR
Lutetium		Indium	STD	Nickel	0.02	Nitrogen	NR
Ytterbium		Cadmium		Cobalt	0.003	Carbon	NR
Thulium		Silver		Iron	0.04	Boron	0.04
Erbium		Palladium		Manganese	0.01	Beryllium	
Holmium		Rhodium		Chromium	0.005	Lithium	0.2
Dysprosium						Hydrogen	NR

NR -- Not Reported

All elements not reported <0.004 µg/ml ~~≤0.[illegible]~~

**Flameless Atomic Absorption

*Not reported upon request

Approved:

CABLE ADDRESS COMTECO

COMMERCIAL TESTING & ENGINEERING CO.
GENERAL OFFICES: 228 NORTH LA SALLE STREET, CHICAGO, ILLINOIS 60601 · AREA CODE 312 726-8434

SINCE 1908

Reply to
Instrumental Analysis Division
14335 West 44th Avenue
Golden, Colorado 80401

Phone: 303-278-9521

October 2, 1974

Mr. Frank Haas
TOSCO
18200 West Hiway 72
Golden, CO 80401

ANALYTICAL REPORT

MG/LITER TOC:

SG-Cb-2B Top Para Cr. 890 ft.	-.1
SGAT #1C D.S.T. 1362-1512 ft.	-.1
SGAT #1C D.S.T. 1515'-1640 ft.	-.1
SGAT #1C D.S.T. 1566-1640 ft.	-.1
SGAT #1C D.S.T. 1566-1640 ft.	-.1
SG #11 1330 ft.	-.1
SG #11 1385 ft.	-.1
SG #11 Depth 2465	-.1
SG #11 2825 ft.	-.1
✓ SG #6 1350 ft. Top of Mining Zone	-.1
✓ SG #6 1425 ft. Bottom of Mining Zone	-.1
✓ SG #6 1547 ft. Below "B" Groove	-.1

Minus sign indicates parameter is below level indicated.
TOC was run on waters marked "Regular".

Sincerely,

M L Jacobs
M. L. Jacobs

MLJ/hb

RECEIVED

OCT 15 1974

JOSCO-GOLDEN

HAZEN RESEARCH, INC.
4601 Indiana Street
Golden, Colorado 80401

Mr. Frank Haas
The Oil Shale Corporation
19200 West Highway 72
Golden, Colorado 80401

Date: September 27, 1974
HRI Project No. 535
HRI Series No. 7371
Samples received: Sept. 13, 1974

REPORT OF ANALYSIS

		pCi/l			pCi/l		
Analysis No.	Sample Designation	α Total	±	α Precision*	β Total	±	β Precision*
7371-1	S.G. A.T. #1 C Dst 1362-1512'	24	±	5	4	±	12
-2	S.G. A.T. #2 Reg. Dst 1566-1640'	4.7	±	3.1	9	±	12
-3	S.G. Cb-2B Top Para Ct. 890'	5.5	±	3.0	15	±	12
-4	S.G. A.T. 1C Dst #3 Reg.1566-1640'	3.6	±	2.8	14	±	12
-5	S.G. #6 1350' Top of mining zone	5.3	±	3.1	12	±	12
-6	S.G. #6 Below B Groove 1547'	5.4	±	3.2	12	±	12
-7	S.G. #6 Bottom of mining zone 1425'	4.5	±	2.7	6	±	12
-8	S.G. #11 1330'	3.4	±	2.8	0	±	13
-9	S.G. 1385'	7.1	±	2.9	3	±	12
-10	S.G. #11 Depth 2465 Top G.G.	4.5	±	3.0	0	±	19
-11	S.G. #11 2825'	2.8	±	2.1	0	±	12
-12	S.G. A.T. 1C Dst-DS water 1515-1640'	8.6	±	2.8	0	±	11

By:
John C. Jarvis
Manager, Analytical Laboratory

ljb

*Variability of the radioactive disintegration process (counting error) at the 95% confidence level, 1.96σ

HAZEN RESEARCH, INC.
4601 Indiana Street
Golden, Colorado 80401

Mr. Frank Haas
The Oil Shale Corporation
13200 West Highway 72
Golden, Colorado 80401

Date: October 14, 1974
HRI Project No. 535
HRI Series No. 7371
Samples received: Sept. 13, 1974

Page 2

REPORT OF ANALYSIS

Analysis No.	Sample Designation	Ra^{226} (pCi/l)	±	Precision*
7371-1	S.G. A.T. 1C DST 1362-1512 ft.	0	±	0.5
-2	S.G. A.T. 2C Req. DST 1566-1640 ft.	0.2	±	0.7
-3	S.G. Cb-2B Top Para Ct. 890 ft.	0	±	0.5
-4	S.G. A.T. 1C DST #3 Reg. 1566-1640 ft.	0.1	±	0.6
✓ -5	S.G. #6 1350 ft. Top of Mining Zone	0	±	0.6
✓ -6	S.G. #6 Below "B" Groove 1547 ft.	0.2	±	0.7
✓ -7	S.G. #6 Bottom of Mining Zone 1425 ft.	0.1	±	0.6
-8	S.G. #11 1330 ft.	0.1	±	0.6
-9	S.G. 1385 ft.	0	±	0.5
-10	S.G. #11 Depth 2465 Top G.G.	0.2	±	0.6
-11	S.G. #11 2825 ft.	0	±	0.5
-12	S.G. A.T. 1C dist. DS Water 1515-1640 ft.	0.7	±	0.7

*Variability of the radioactive disintegration process (counting error) at the 95% confidence level, 1.96σ

By:
John C. Jarvis
Manager, Analytical Laboratory

ljb

WATER QUALITY ANALYSES

SG - 9

TRACT C-b

TABLE 1

MAJOR CONSTITUENT ANALYSES, CORE HOLE SG-9

	993 Feet		1200 Feet		1285 Feet		1360 Feet		2750 Feet
Component, mg/l	Industrial	TOSCO	Industrial	TOSCO	Industrial	TOSCO	Industrial	TOSCO	TOSCO
Na	177	164	190	182	210	191	225	221	232
K	NA	0.3	NA	0.4	NA	0.7	NA	0.6	1
Ca	9.8	6.3	7	4	6.6	5	5.7	5.2	7
Mg	6.7	4.9	3	4	4.3	3.3	5.8	4.4	4.9
SO_4	22	12	<4	3	7.4	6	7.7	8.9	15.4
CO_3	12	5	12	0	<0.1	0	<0.1	0	0
HCO_3	426	417	450	461	526	515	586	586	650
Cl	<4	2	<4	2	2.1	1.4	1.4	2.3	3.2
F	9.8	9	10	13	10	14	10	14	14
Σ Cations, meq/l	8.74	7.86	8.86	8.45	9.82	8.84	10.55	10.26	10.89
Σ Anions, meq/l	8.36	7.78	8.30	8.36	9.30	9.34	10.29	10.59	11.80
% Difference	2.2	0.5	3.3	0.5	2.7	2.7	1.2	1.6	4.0
Silica, mg/l	15	16	12	13	13	14	12	11	11
pH	8.9	8.5	8.5	8.2	7.9	8.2	7.4	8.0	8.2
Calculated TDS, mg/l	461	424	454	447	511	488	555	555	607

NA - Not Analyzed

THE INDUSTRIAL LABORATORIES COMPANY

Analytical and Consulting Chemists

2600 WEST 29TH AVENUE
DENVER, COLORADO 80211
TELEPHONE 455-3641

ANALYSIS REPORT

ATLANTIC RICHFIELD COMPANY

DATE RECEIVED: 10/17/74
DATE REPORTED: 11/4/74

LAB. NUMBER: 4795

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SAMPLE MARKED: Sorghum Gulch #9 993 Feet Top of Parachute Creek

ANALYSIS:

	MILLIGRAMS PER LITER	MILLI-EQUIVALENTS
Calcium	9.8	0.489
Magnesium	6.7	0.551
Sodium	177	7.700
Carbonate	12	0.400
Bicarbonate	426	6.985
Chloride	Less than 4.0	-----
Sulfate	22	0.458
Nitrate	Less than 0.1	-----
Phosphate	Less than 0.1	-----
Silicon dioxide	15	0.500
Iron	0.95	-----
Fluoride	9.8	0.519
P. alkalinity, in terms of calcium carbonate	000	
MO alkalinity, in terms of calcium carbonate	----	
Hardness, in terms of calcium carbonate	52	
Total dissolved solids (calculated)	482	
Ammonia	0.2	
Lithium	Less than 0.5	
Barium	Less than 1.0	
Hexavalent chromium	Less than 0.01	
Arsenic	0.01	
Selenium	Less than 0.01	
Boron	0.7	
Hydroxide	Less than 0.1	

Σ Cations = 8.74
Σ Anions = 8.36
% Difference = 2.2

	MILLIGRAMS PER LITER
Aluminum	5.4
Copper	Less than 0.1
Cadmium	Less than 0.01
Lead	Less than 0.05
Manganese	Less than 0.05
Silver	Less than 0.01
Zinc	Less than 0.5
Mercury	Less than 0.01

pH 8.9
Specific conductance 620 micromhos per cc

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DENVER, COLORADO 80211
ANALYSIS REPORT

TELEPHONE 455-3641

ATLANTIC RICHFIELD COMPANY

DATE RECEIVED: 10/17/74
DATE REPORTED: 11/4/74

LAB. NUMBER: 3786

SAMPLES ARE DISCARDED IN 15 DAYS FROM DATE OF REPORT UNLESS WE ARE REQUESTED, IN WRITING, TO RETAIN THEM FOR A LONGER PERIOD. PERISHABLE SAMPLES ARE USUALLY DISCARDED IMMEDIATELY UNLESS CLIENT HAS REQUESTED SPECIAL HANDLING (FREEZING, ETC.) IN ADVANCE.

SAMPLE MARKED: Sorghum Gulch #3 1200 Feet (Core Point)

ANALYSIS:

	MILLIGRAMS PER LITER	MILLI-EQUIVALENTS
Calcium	7.0	0.349
Magnesium	3.0	0.247
Sodium	190	8.265
Carbonate	12	0.400
Bicarbonate	450	7.380
Chloride	Less than 4.0	-----
Sulfate	Less than 4.0	-----
Nitrate	Less than 0.1	-----
Phosphate	Less than 0.1	-----
Silicon dioxide	12	0.400
Iron	0.95	-----
Fluoride	10	0.523
P. alkalinity, in terms of calcium carbonate	--	
MO alkalinity, in terms of calcium carbonate	--	
Hardness, in terms of calcium carbonate	30	
Total dissolved solids (calculated)	443	
Ammonia	0.3	
Lithium	Less than 0.5	
Barium	Less than 1.0	
Hexavalent chromium	Less than 0.01	
Arsenic	Less than 0.01	
Selenium	Less than 0.01	
Boron	0.6	
Hydroxide	Less than 0.1	

Σ Cations = 8.86
Σ Anions = 8.30
% Difference = 3.3

	MILLIGRAMS PER LITER
Aluminum	7.4
Copper	Less than 0.1
Cadmium	Less than 0.01
Lead	Less than 0.05
Manganese	Less than 0.05
Silver	Less than 0.01
Zinc	Less than 0.5
Mercury	Less than 0.01

pH 8.5
Specific conductance 690 micromhos per cc

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Analytical and Consulting Chemists

2600 WEST 29TH AVENUE
DENVER, COLORADO 80211

TELEPHONE 455-3641

ANALYSIS REPORT

ATLANTIC RICHFIELD COMPANY

DATE RECEIVED: 10/17/74
DATE REPORTED: 10/29/74

LAB. NUMBER: 3763

SAMPLES ARE DISCARDED IN 15 DAYS FROM DATE OF REPORT UNLESS WE ARE REQUESTED, IN WRITING, TO RETAIN THEM FOR A LONGER PERIOD. PERISHABLE SAMPLES ARE USUALLY DISCARDED IMMEDIATELY UNLESS CLIENT HAS REQUESTED SPECIAL HANDLING (FREEZING, ETC.) IN ADVANCE.

SAMPLE MARKED: Sorghum Gulch #9 (Top) 1,285 Feet

ANALYSIS:

	MILLIGRAMS PER LITER		MILLI-EQUIVALENTS
Calcium	6.6		0.329
Magnesium	4.3		0.354
Sodium	210	Σ Cations = 9.82	9.135
Carbonate	Less than 0.1		-----
Bicarbonate	526	Σ Anions = 9.30	8.626
		% Difference = 2.7	
Chloride	2.1		-----
Sulfate	7.4		0.154
Nitrate	Less than 0.1		-----
Phosphate	Less than 0.1		-----
Silicon dioxide	13		0.433
Iron	0.08		-----
Fluoride	10		0.523
Hardness, in terms of calcium carbonate	34		-----
Ammonia	0.5		MILLIGRAMS PER LITER
Lithium	Less than 0.5		
		Manganese	Less than 0.05
Barium	Less than 1.0	Silver	Less than 0.01
Hexavalent chromium	Less than 0.01	Zinc	Less than 0.5
Arsenic	Less than 0.01	Mercury	Less than 0.01
Selenium	Less than 0.01	Total dissolved solids	510
Boron	0.6		
Hydroxide	Less than 0.1		
Aluminum	0.8		
Copper	Less than 1.0	pH 7.9	
Cadmium	Less than 0.01	Specific conductance	820 micromhos percc
Lead	Less than 0.05		

cc: John Matis/Frank Haas

THE INDUSTRIAL LABORATORIES COMPANY

CHEMIST

MEMBERS OF:
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AMERICAN CHEMICAL SOCIETY
AMERICAN OIL CHEMISTS' SOCIETY
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THE INDUSTRIAL LABORATORIES COMPANY

Analytical and Consulting Chemists

2600 WEST 29TH AVENUE
DENVER, COLORADO 80211

TELEPHONE 455-3641

ANALYSIS REPORT

ATLANTIC RICHFIELD COMPANY

DATE RECEIVED: 10/17/74
DATE REPORTED: 10/[illegible]/74

LAB. NUMBER: 3754

SAMPLES ARE DISCARDED IN 15 DAYS FROM DATE OF REPORT UNLESS WE ARE REQUESTED, IN WRITING, TO RETAIN THEM FOR A LONGER PERIOD. PERISHABLE SAMPLES ARE USUALLY DISCARDED IMMEDIATELY UNLESS CLIENT HAS REQUESTED SPECIAL HANDLING (FREEZING, ETC.) IN ADVANCE.

SAMPLE MARKED: Sorghum Gulch #9 (Bottom) 1,350 Feet

ANALYSIS:

	MILLIGRAMS PER LITER	MILLI-EQUIVALENTS
Calcium	5.7	0.284
Magnesium	5.8	0.477
Sodium	225	9.789
Carbonate	Less than 0.1	-----
Bicarbonate	586	9.610
Chloride	1.4	-----
Sulfate	7.7	0.160
Nitrate	Less than 0.1	-----
Phosphate	Less than 0.1	-----
Silicon dioxide	12	0.400
Iron	0.05	-----
Fluoride	10	0.523
Hardness, in terms of calcium carbonate	38	
Ammonia	0.5	
Lithium	Less than 0.5	
Barium	Less than 1.0	
Hexavalent chromium	Less than 0.01	
Arsenic	Less than 0.01	
Selenium	Less than 0.01	
Boron	0.5	
Hydroxide	Less than 0.1	
Aluminum	0.08	
Copper	Less than 0.1	
Cadmium	Less than 0.01	
Lead	Less than 0.05	

Σ Cations = 10.55
Σ Anions = 10.29
% Difference = 1.2

	MILLIGRAMS PER LITER
Manganese	Less than 0.05
Silver	Less than 0.01
Zinc	Less than 0.5
Mercury	Less than 0.01
Total dissolved solids	558

pH 7.4
Specific conductance 930 micromhos per cc

MEMBERS OF: cc: John Matis/Frank Haas

AMERICAN ASS'N OF CEREAL CHEMISTS
AMERICAN CHEMICAL SOCIETY
AMERICAN OIL CHEMISTS' SOCIETY
ASS'N OF OFFICIAL RACING CHEMISTS
BAKERY [illegible] OF AMERICA
INSTITUTE OF FOOD TECHNOLOGY
SIGMA XI

THE INDUSTRIAL LABORATORIES COMPANY
H. Paul Ochs
CHEMIST

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CABLE ADDRESS COMTECO

COMMERCIAL TESTING & ENGINEERING CO.

GENERAL OFFICES: 228 NORTH LA SALLE STREET, CHICAGO, ILLINOIS 60601 • AREA CODE 312 726-8434

SINCE 1908

Reply to
Instrumental Analysis Division
14335 West 44th Avenue
Golden, Colorado 80401

Phone: 303-278-9521

20 November 74

Mr. Frank Haas
The Oil Shale Corporation
18200 West Hiway 72
Golden, CO 80401

Re: IAD #97-153-002-04

ANALYTICAL REPORT

	TOC* mg/liter	Nitrates** mg/liter N
Aquifer Test #1 after pumping 15 hrs.	<1	0.34
Well 1-C String #2	8	0.10
ARCO SG #18-A T.D. 1330'	<1	0.22
ARCO SG-9 2750'	<1	0.056

*Test performed on samples marked "Regular" and run by an outside laboratory.

**Test performed on samples marked "Hg for N"

Charles R. Wilson
Charles R. Wilson
Analyst

M L Jacobs
Approved by:
M. L. Jacobs Ph.D.
Divisional Manager

CRW/hb

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TOSCO-GOLDEN

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SINCE 1908

Reply to
Instrumental Analysis Division
14335 West 44th Avenue
Golden, Colorado 80401

Phone: 303-278-9521

12 November 74

Mr. Frank Haas
The Oil Shale Corporation
18200 West Hiway 72
Golden, Colorado 80401

Re: IAD #97-140-002-33

ANALYTICAL REPORT

Samples	TOC* mg/liter	Nitrate** mg/liter N	Free Ammonia** mg/liter N
ARCO et.al. SG #18 c-b @ 1380'	3	0.26	0.017
ARCO et.al. SG #18 960' Top of para Cr. 800 mΩ	3	<0.04	0.013
ARCO et.al. Wtr. samples SG #19 Top of para Cr. @ 466'	4	0.28	0.012
ARCO SG #19 @ 860'	4	0.21	0.018
ARCO SG #19 TD @ 981'	3	0.34	0.040
✓ SG #9 Top of Mining Zone 1285'	3	3.35	0.025
SG #18 Base of Mining Zone TD 1425.6 (800mΩ)	3	3.40	0.029
✓ SG #9 Btm of Mining Zone @ 1360'	4	0.27	0.042
✓ ARCO SG #9 Core Point @ 1200'	4	0.76	0.022
✓ ARCO et.al. SG #9 @ 993' Top of parachute creek 800 mΩ	4	0.32	0.013

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* Test performed on samples marked 'Regular'
** Test performed on samples marked 'Hg for N'

Charles R. Wilson
Charles R. Wilson, Analyst

Approved by:
M. L. Jacobs, Ph.D.
Divisional Manger

CRW/dh

COMMERCIAL TESTING & ENGINEERING CO.
GENERAL OFFICES: 228 NORTH LA SALLE STREET, CHICAGO, ILLINOIS 60601 · AREA CODE 312 726-8434
Reply to INSTRUMENTAL ANALYSIS DIVISION, 14335 WEST AVENUE, GOLDEN, COLORADO, 80401, PHONE: 303-278-9521

To: Mr. Frank Haas
The Oil Shale Corporation
18200 West Hiway 72
Golden, Colorado 80401

Date: 8 November 74

Analyst: S. Sweeney

P. O. No.:

Sample No.: ARCO et.al. SG #9 @ 993' Top of Parachute Cr.

IAD No.: 97-140-002-33

CONCENTRATION IN μg/ml

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium		Terbium		Ruthenium		Vanadium	<0.001
Thorium		Gadolinium		Molybdenum		Titanium	0.04
Bismuth		Europium		Niobium		Scandium	<0.001
Lead	0.02	Samarium		Zirconium		Calcium	*
Thallium		Neodymium		Yttrium	0.001	Potassium	*
Mercury	**0.0001	Praseodymium		Strontium	5	Chlorine	*
Gold		Cerium	0.002	Rubidium	0.02	Sulfur	*
Platinum		Lanthanum	0.002	Bromine	0.005	Phosphorus	0.6
Iridium		Barium	0.02	Selenium		Silicon	*
Osmium		Cesium	0.002	Arsenic		Aluminum	0.5
Rhenium		Iodine		Germanium		Magnesium	*
Tungsten		Tellurium		Gallium	0.003	Sodium	*
Tantalum		Antimony		Zinc	0.02	Fluorine	*
Hafnium		Tin		Copper	0.007	Oxygen	NR
Lutetium		Indium	STD	Nickel	0.005	Nitrogen	NR
Ytterbium		Cadmium		Cobalt	0.002	Carbon	NR
Thulium		Silver		Iron	0.4	Boron	0.002
Erbium		Palladium		Manganese	0.1	Beryllium	
Holmium		Rhodium		Chromium	0.002	Lithium	0.2
Dysprosium						Hydrogen	NR

NR – Not Reported
All elements not reported <0.003 μg/ml
* Not reported upon request
** Flameless Atomic Absorption

Approved: M Jacobs

COMMERCIAL TESTING & ENGINEERING CO.
GENERAL OFFICES: 228 NORTH LA SALLE STREET, CHICAGO, ILLINOIS 60601 • AREA CODE 312 726-8434
Reply to INSTRUMENTAL ANALYSIS DIVISION, 14335 WEST AVENUE, GOLDEN, COLORADO, 80401, PHONE: 303-278-9521

To: Mr. Frank Haas
The Oil Shale Corporation
18200 West Hiway 72
Golden, Colorado 80401

Date: 8 November 74

Analyst: S. Sweeney

P. O. No.:

Sample No.: ARCO SG #9 Core Point @ 1200'

IAD No.: 97-140-002-33

CONCENTRATION IN µg/ml

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium		Terbium		Ruthenium		Vanadium	0.004
Thorium		Gadolinium		Molybdenum	0.006	Titanium	0.03
Bismuth		Europium		Niobium		Scandium	
Lead	0.02	Samarium		Zirconium	0.003	Calcium	*
Thallium		Neodymium		Yttrium		Potassium	*
Mercury	**0.0001	Praseodymium		Strontium	0.3	Chlorine	*
Gold		Cerium	0.003	Rubidium	0.004	Sulfur	*
Platinum		Lanthanum	0.003	Bromine	0.02	Phosphorus	0.5
Iridium		Barium	0.05	Selenium		Silicon	*
Osmium		Cesium		Arsenic	0.02	Aluminum	4
Rhenium		Iodine	0.002	Germanium		Magnesium	*
Tungsten		Tellurium		Gallium		Sodium	*
Tantalum		Antimony		Zinc	0.3	Fluorine	*
Hafnium		Tin		Copper	0.1	Oxygen	NR
Lutetium		Indium	STD	Nickel	0.05	Nitrogen	NR
Ytterbium		Cadmium		Cobalt	0.01	Carbon	NR
Thulium		Silver		Iron	2	Boron	0.03
Erbium		Palladium		Manganese	0.08	Beryllium	0.001
Holmium		Rhodium		Chromium	0.005	Lithium	0.5
Dysprosium						Hydrogen	NR

NR — Not Reported
All elements not reported <0.003 µg/ml
* Not reported upon request
** Flameless Atomic Absorption

Approved:

COMMERCIAL TESTING & ENGINEERING CO.
GENERAL OFFICES: 228 NORTH LA SALLE STREET, CHICAGO, ILLINOIS 60601 • AREA CODE 312 726-8434
Reply to INSTRUMENTAL ANALYSIS DIVISION, 14335 WEST AVENUE, GOLDEN, COLORADO, 80401, PHONE: 303-278-9521

To: Mr. Frank Haas
The Oil Shale Corporation
18200 West Hiway 72
Golden, Colorado 80401

Date: 8 November 74

Analyst: S. Sweeney

P. O. No.:

Sample No.: SG #9 Top of Mining Zone 1285'

IAD No.: 97-140-002-33

CONCENTRATION IN μg/ml

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium		Terbium		Ruthenium		Vanadium	0.008
Thorium		Gadolinium		Molybdenum	0.02	Titanium	
Bismuth		Europium		Niobium		Scandium	0.002
Lead	0.04	Samarium		Zirconium	0.01	Calcium	*
Thallium		Neodymium		Yttrium		Potassium	*
Mercury	**0.0001	Praseodymium		Strontium	0.4	Chlorine	*
Gold		Cerium		Rubidium	0.4	Sulfur	*
Platinum		Lanthanum		Bromine	0.02	Phosphorus	0.5
Iridium		Barium	0.7	Selenium	0.05	Silicon	*
Osmium		Cesium	0.02	Arsenic	0.12	Aluminum	14
Rhenium		Iodine		Germanium	0.01	Magnesium	*
Tungsten		Tellurium		Gallium		Sodium	*
Tantalum		Antimony		Zinc	0.4	Fluorine	*
Hafnium		Tin		Copper	0.05	Oxygen	NR
Lutetium		Indium	STD	Nickel	0 .1	Nitrogen	NR
Ytterbium		Cadmium		Cobalt	0.03	Carbon	NR
Thulium		Silver		Iron	8	Boron	0.08
Erbium		Palladium		Manganese	0 .3	Beryllium	0.001
Holmium		Rhodium		Chromium	0.01	Lithium	0.4
Dysprosium						Hydrogen	NR

NR -- Not Reported
All elements not reported <0.009 μg/ml
** Flameless Atomic Absorption
* Not reported upon request

Approved:

COMMERCIAL TESTING & ENGINEERING CO.
GENERAL OFFICES: 228 NORTH LA SALLE STREET, CHICAGO, ILLINOIS 60601 • AREA CODE 312 726-8434
Reply to INSTRUMENTAL ANALYSIS DIVISION, 14335 WEST AVENUE, GOLDEN, COLORADO, 80401, PHONE: 303-278-9521

To: Mr. Frank Haas
The Oil Shale Corporation
18200 West Hiway 72
Golden, Colorado 80401

Date: 8 November 74

Analyst: S. Sweeney

P. O. No.:

Sample No.: SG #9 Btm. of Mining Zone @ 1360'

IAD No.: 97-140-002-33

CONCENTRATION IN µg/ml

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium		Terbium		Ruthenium		Vanadium	0.002
Thorium		Gadolinium		Molybdenum	0.003	Titanium	0.2
Bismuth		Europium		Niobium		Scandium	
Lead	0.02	Samarium		Zirconium		Calcium	*
Thallium		Neodymium		Yttrium		Potassium	*
Mercury	**0.0001	Praseodymium		Strontium	0.6	Chlorine	*
Gold		Cerium	0.004	Rubidium	0.007	Sulfur	*
Platinum		Lanthanum		Bromine		Phosphorus	0.1
Iridium		Barium	0.5	Selenium		Silicon	*
Osmium		Cesium	0.003	Arsenic	0.007	Aluminum	0.6
Rhenium		Iodine		Germanium		Magnesium	*
Tungsten		Tellurium		Gallium		Sodium	*
Tantalum		Antimony		Zinc	0.03	Fluorine	*
Hafnium		Tin		Copper	0.01	Oxygen	NR
Lutetium		Indium	STD	Nickel	0.02	Nitrogen	NR
Ytterbium		Cadmium		Cobalt	0.02	Carbon	NR
Thulium		Silver		Iron	2	Boron	0.1
Erbium		Palladium		Manganese	0.05	Beryllium	
Holmium		Rhodium		Chromium	0.004	Lithium	0.1
Dysprosium						Hydrogen	NR

NR -- Not Reported
All elements not reported <0.006 µg/ml
* Not reported upon request
** Flameless Atomic Absorption

Approved: M J Jacobs

COMMERCIAL TESTING & ENGINEERING CO.
GENERAL OFFICES: 228 NORTH LA SALLE STREET, CHICAGO, ILLINOIS 60601 • AREA CODE 312 726-8434
Reply to INSTRUMENTAL ANALYSIS DIVISION, 14335 WEST AVENUE, GOLDEN, COLORADO, 80401, PHONE: 303-278-9521

To: Mr. Frank Haas
The Oil Shale Corporation
18200 West Hiway 72
Golden, CO 80401

Date: 20 November 74

Analyst: S. Sweeney

P. O. No.:

Sample No.: ARCO Sg-9 2750'

IAD No.: 97-153-002-04

CONCENTRATION IN µg/ml

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium		Terbium		Ruthenium		Vanadium	0.001
Thorium		Gadolinium		Molybdenum	0.02	Titanium	0.05
Bismuth		Europium		Niobium	<0.001	Scandium	0.001
Lead	0.02	Samarium		Zirconium		Calcium	*
Thallium		Neodymium		Yttrium		Potassium	*
Mercury	**0.0028	Praseodymium		Strontium	0.4	Chlorine	*
Gold		Cerium		Rubidium	0.01	Sulfur	*
Platinum		Lanthanum		Bromine	0.02	Phosphorus	0.9
Iridium		Barium	0.04	Selenium		Silicon	*
Osmium		Cesium	0.002	Arsenic	0.009	Aluminum	0.2
Rhenium		Iodine		Germanium		Magnesium	*
Tungsten		Tellurium		Gallium	0.001	Sodium	*
Tantalum		Antimony		Zinc	0.02	Fluorine	*
Hafnium		Tin		Copper	0.02	Oxygen	NR
Lutetium		Indium	STD	Nickel	0.02	Nitrogen	NR
Ytterbium		Cadmium		Cobalt	0.008	Carbon	NR
Thulium		Silver		Iron	0.2	Boron	0.08
Erbium		Palladium		Manganese	0.01	Beryllium	<0.001
Holmium		Rhodium		Chromium	0.003	Lithium	0.8
Dysprosium						Hydrogen	NR

NR -- Not Reported
All elements not reported < 0.002 µg/ml
*Not reported upon request
**Flameless Atomic Absorption

Approved: M J Jacobs

HAZEN RESEARCH, INC.
4601 Indiana Street
Golden. Colorado 80401

Mr. Frank Haas
The Oil Shale Corporation
18200 West Highway 72
Golden, Colorado 80401

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TOSCO-G

Date: November 27, 1974
HRI Project No. 535
HRI Series No. 7515
Samples received: Oct. 22, 1974

REPORT OF ANALYSIS

Analysis No.	Sample Description	pCi/l α Total	±	α Precision*	pCi/l β Total	±	β Precision*	pCi/l Ra^{226}	±	Precision*
7515-1	Stewart Gulch-Spring at Mouth	3.4	±	2.7	0	±	11			
-2	Middle Stewart Gulch	2.8	±	2.5	0	±	12			
-3	Savage Cabin-Stewart Gulch	4.0	±	2.5	0	±	11			
-4	East Stewart Gulch	2.1	±	2.2	0	±	12			
-5	Spring at Oland House	4.6	±	2.8	0	±	12			
-6	Willow Creek West of PL Ranch	3.3	±	2.6	0	±	12			
-7	Willow Creek 3/4 mi. past Scandard	4.7	±	2.8	0	±	12	0	±	0.8
-8	Willow Creek 2 mi. past Scandard	1.3	±	2.1	0	±	12			
-9	Willow Creek Mouth-Scandard	4.2	±	2.8	0	±	12	0.3	±	0.5
-10	Spring-PL Ranch	1.6	±	2.2	0	±	12			
-11	A-1	4.3	±	3.4	0	±	15	0.2	±	0.5
-12	A-2 85'	2.3	±	3.6	0	±	14			
-13	A-3 107'	0	±	3.1	0	±	14			
-14	A-5 86'	0	±	3.0	0	±	14			
-15	A-6 60'	2.9	±	4.2	0	±	15			
-16	A-7 57'	14	±	6	6	±	21	0.3	±	0.4
-17	A-8	0	±	2.9	9	±	14			
-18	A-8 70'	1.5	±	3.7	0	±	14			
-19	A-9 57'	0	±	2.6	0	±	13			
-20✓	9 Core Point-1200'	1.7	±	1.8	0	±	13			

*Variability of the radioactive disintegration process (counting error) at the 95% confidence level, 1.96σ

HAZEN RESEARCH, INC.
4601 Indiana Street
Golden, Colorado 80401

Mr. Frank Haas
The Oil Shale Corporation

Date: November 27, 1974
HRI Project No. 535
HRI Series No. 7515
Samples received: Oct. 22, 1974

Page 2

REPORT OF ANALYSIS

Analysis No.	Sample Description	pCi/l α Total	±	α Precision*	pCi/l β Total	±	β Precision*	pCi/l Ra^{226}	±	Precision*
7515-21 ✓	9 Bottom-1360'	1.5	±	2.7	0	±	15			
-22 ✓	Top of parachute 9 Creek-993'	3.4	±	2.1	0	±	13			
-23 ✓	Top of mining zone 9-1285'	5.7	±	2.7	0	±	14	0.9	±	0.6
-24	A-10 67'	2.3	±	2.5	0	±	14			
-25	A-11 56'	2.2	±	2.6	0	±	14			
-26	A-11 66'	5.0	±	3.2	0	±	15	0	±	0.3
-27	A-12 78'	1.6	±	2.4	0	±	14			
-28	18-Base 1425.6'	4.0	±	2.2	0	±	13			
-29	18-1380'	1.8	±	1.9	0	±	13			
-30	Top of para. 18-960'	0.6	±	1.7	0	±	13			
-31	Top of para. 19-466'	2.8	±	2.1	0	±	13			
-32	19-860'	0.7	±	2.6	0	±	15			
-33	19-TD-981'	0	±	3.4	0	±	33			

*Variability of the radioactive disintegration process (counting error) at the 95% confidence level, 1.96σ

By: John C. Jarvis
John C. Jarvis
Manager, Analytical Laboratory

ljb

HAZEN RESEARCH, INC.
4601 Indiana Street
Golden, Colorado 80401

Mr. F. C. Haas
The Oil Shale Corporation
18200 West Highway 72
Golden, Colorado 80401

Date: December 3, 1974
HRI Project No. - 535
HRI Series No. 7559
Samples received: November 1, 1974

REPORT OF ANALYSIS

Analysis No.	Sample Designation	α Total	pCi/l ±	α Precision*	β Total	pCi/l ±	β Precision*	Ra^{226}	pCi/l ±	Precision*
7559-1	Aquifer Test #1 Pumped 15 hrs.	4.2	±	2.3	0	±	11	0.3	±	0.5
-2	Well #1-C String #2	0.6	±	3.4	9	±	12			
-3 ✓	SG-9 2750'	5.5	±	2.6	0	±	11	0	±	0.4
-4	SG-18-A TD 1380	8.0	±	3.3	0	±	11	0.1	±	0.4

By: John C. Jarvis
John C. Jarvis
Manager, Analytical Laboratory

ljb

*Variability of the radioactive disintegration process (counting error) at the 95% confidence level, 1.96σ

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WATER QUALITY ANALYSES

SG - 10

TRACT C-b

TABLE 1

MAJOR CONSTITUENT ANALYSES

CORE HOLE NO. SG-10

Element	960 Feet			1336 Feet			1416 Feet			2211 Feet	
	Ind.	C&L	TOSCO	Ind.	C&L	TOSCO	Ind.	C&L	TOSCO	Ind.	TOSCO
Sodium, mg/l	160	140	146	180	190	218	230	215	236	440	570
Potassium, mg/l	ND	0.4	0.4	ND	0.65	0.5	ND	0.5	0.5	ND	3.2
Calcium, mg/l	29	46	27	9.8	14	8	6.6	13	7.6	16	14.8
Magnesium, mg/l	26	18	19	9.6	4.0	3.8	13	4	3.8	3.7	7.0
Sulfate, mg/l	170	150	149	21	25	13	27	24	9	55	63
Carbonate, mg/l	37	13	6	31	16	6	37	17	23	34	28
Bicarbonate, mg/l	320	332	330	510	502	518	573	547	535	830	1212
Chloride, mg/l	18	4.4	3.1	15	0.5	0.1	14	3.0	1.4	120	103
Fluoride, mg/l	3.5	3.3	3.0	8.0	14	15	18	14	15	16	17
Σ Cations, meq/l	10.58	9.90	9.24	9.12	9.31	10.21	11.41	10.34	10.97	20.24	26.18
Σ Anions, meq/l	10.71	9.29	8.96	10.67	10.05	9.74	12.48	10.84	10.53	20.10	26.76
% Difference	0.6	3.2	1.5	7.8	3.8	2.4	4.5	2.4	2.0	0.3	1.1
Silica, mg/l	24	34	21	13	11	13	13	11	11	15	15
pH	8.4	8.3	8.4	8.5	8.4	8.4	8.5	8.3	8.8	8.2	8.5
Calcuated TDS, mg/l	624	572	536	537	522	531	639	570	569	1106	1415
Density @ 22°C, g/ml			0.9986			0.9984			0.9985		0.9983

TABLE 2

MINOR CONSTITUENTS

CORE HOLE NO. SG-10

Element	960 Feet		1336 Feet		1416 Feet		2211 Feet	
	Ind.	C&L	Ind.	C&L	Ind.	C&L	Ind.	C&L
Cyanide, mg/l	< 0.2	< 0.05	< 0.2	< 0.05	< 0.2	< 0.05	< 0.01	0.10
Phosphate, mg/l	< 0.1	0.02	< 0.1	< 0.01	< 0.1	< 0.01	< 0.1	< 0.01
Lithium, mg/l	< 0.5	< 0.05	< 0.5	< 0.05	0.6	< 0.05	< 0.5	0.84
Phenols, mg/l	< 0.05	< 0.05	< 0.003	< 0.05	< 0.003	< 0.05	< 0.001	< 0.05
BOD	0.3	12.5	0.4	12.5	0.9	12.5	ND	ND
COD	14	2.9	< 0.5	< 0.4	4.7	18	11	ND
Sulfide, mg/l	< 0.1	0.03	< 0.1	0.06	< 0.1	0.06	< 0.1	< 0.03
Ammonia, mg/l	2.1	0.27	1.8	0.77	1.9	0.65	7.0	2.9
Nitrite, mg/l		< 0.005		< 0.005		< 0.005		ND
Nitrate, mg/l	0.32	0.22	0.56	0.26	0.74	0.32		ND
Total Organic Carbon, mg/l	ND	0.7	ND	0.7	ND	31	ND	9
Oil and Grease	ND	0.001	ND	0.023	ND	0.027	ND	0.007
Color	ND	2	ND	6	ND	10	ND	9
Odor	ND	0	ND	0	ND	4	ND	0
*Gross α, p Ci/l	2.9 ± 1.9		9.2 ± 2.7		1.4 ± 1.4		5.1 ± 3.5	
Radium 226, p Ci/l			0 ± 0.4				0 ± 1.9	
*Gross β, p Ci/l	0 ± 10		0 ± 12		0 ± 11		0 ± 20	

*Gross α (including Ra 226) and β done by Hazen Research, Inc.

C & L LABORATORIES

Elemental Analysis — Mass Spectrometry

General Analytical Services

14335 West 44th Ave
Golden, Colo. 80401
(303) 278-9521

To: Mr. Frank Haas
The Oil Shale Corp.
18200 West Hiway 72
Golden, CO 80401

Date: 8-5-74

Analyst: S. Sweeney

Customer No.:

C & L No.: 97-057-002-11

Sample No.: TOSCO 1416' depth SG #10

CONCENTRATION IN PPM WEIGHT

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium		Terbium		Ruthenium		Vanadium	0.003
Thorium		Gadolinium		Molybdenum	0.03	Titanium	0.04
Bismuth		Europium		Niobium	0.0006	Scandium	0.01
Lead		Samarium		Zirconium		Calcium	*
Thallium		Neodymium		Yttrium		Potassium	*
Mercury	*	Praseodymium		Strontium	0.6	Chlorine	*
Gold		Cerium		Rubidium	0.003	Sulfur	*
Platinum		Lanthanum		Bromine	0.002	Phosphorus	*
Iridium		Barium	0.04	Selenium	0.004	Silicon	*
Osmium		Cesium	0.0009	Arsenic	0.006	Aluminum	2
Rhenium		Iodine		Germanium	0.001	Magnesium	*
Tungsten	**	Tellurium		Gallium	0.001	Sodium	*
Tantalum	**	Antimony		Zinc	0.09	Fluorine	*
Hafnium		Tin		Copper	0.006	Oxygen	NR
Lutetium		Indium	STD	Nickel	0.05	Nitrogen	NR
Ytterbium		Cadmium		Cobalt	0.04	Carbon	NR
Thulium		Silver	0.001	Iron	0.6 <	Boron	
Erbium		Palladium		Manganese	0.01	Beryllium	
Holmium		Rhodium		Chromium	0.04	Lithium	*
Dysprosium						Hydrogen	NR

NR - Not Reported

All elements not reported [illegible] <0.001 µg/ml

**Source Contamination

*Reported by different methods

C & L LABORATORIES

Elemental Analysis — Mass Spectrometry

General Analytical Services

14335 West 44th Ave
Golden, Colo. 80401
(303) 278-9521

To: Mr. Frank Haas
The Oil Shale Corp.
18200 West Hiway 72
Golden, CO 80401

Date: 8-5-74

Analyst: S. Sweeney

Customer No.:

C & L No.: 97-074-002-03

Sample No.: TOSCO 2211' depth SG #10

CONCENTRATION IN PPM WEIGHT

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium	0.002	Terbium		Ruthenium		Vanadium	0.01
Thorium		Gadolinium		Molybdenum	0.03	Titanium	0.5
Bismuth		Europium	0.002	Niobium	0.0006	Scandium	0.003
Lead		Samarium		Zirconium	0.01	Calcium	*
Thallium		Neodymium		Yttrium	0.0003	Potassium	*
Mercury	*	Praseodymium	0.0009	Strontium	1	Chlorine	*
Gold		Cerium		Rubidium	0.08	Sulfur	*
Platinum		Lanthanum		Bromine	0.1	Phosphorus	*
Iridium		Barium	0.2	Selenium	0.004	Silicon	*
Osmium		Cesium	0.01	Arsenic	0.02	Aluminum	19
Rhenium		Iodine	0.01	Germanium	0.01	Magnesium	*
Tungsten	**	Tellurium		Gallium	0.002	Sodium	*
Tantalum	**	Antimony		Zinc	0.09	Fluorine	*
Hafnium		Tin		Copper	0.1	Oxygen	NR
Lutetium		Indium	STD	Nickel	0.03	Nitrogen	NR
Ytterbium		Cadmium		Cobalt	0.004	Carbon	NR
Thulium		Silver		Iron	4	Boron	
Erbium		Palladium		Manganese	0.2	Beryllium	0.00006
Holmium		Rhodium		Chromium	0.04	Lithium	*
Dysprosium						Hydrogen	NR

NR - Not Reported   <0.001 µg/ml   [illegible]
All elements not reported [illegible]
**Source Contamination   *Reported by different methods

THE INDUSTRIAL LABORATORIES COMPANY

Analytical and Consulting Chemists

2600 WEST 29TH AVENUE
DENVER, COLORADO 80211
ANALYSIS REPORT

TELEPHONE 455-3641

ATLANTIC RICHFIELD COMPANY

DATE RECEIVED:	6/19/74
DATE REPORTED:	6/27/74
LAB. NUMBER:	787

SAMPLES ARE DISCARDED IN 15 DAYS FROM DATE OF REPORT UNLESS WE ARE REQUESTED, IN WRITING, TO RETAIN THEM FOR A LONGER PERIOD. PERISHABLE SAMPLES ARE USUALLY DISCARDED IMMEDIATELY UNLESS CLIENT HAS REQUESTED SPECIAL HANDLING (FREEZING, ETC.) IN ADVANCE.

960

SAMPLE MARKED: SG #10 960 Feet

ANALYSIS:

			MILLIGRAMS PER LITER
Calcium		1.45	29
Magnesium		2.17	26
Sodium		6.96	160
Carbonate	1.23	10.58	37
Bicarbonate	5.25		320
Chloride	0.51		18
Sulfate	3.54 10.53		170
Nitrate			0.32
Phosphate			Less than 0.1
Silicon dioxide			24
Iron			Less than 0.05
Fluoride			3.5
P. alkalinity, in terms of calcium carbonate			30
MO alkalinity, in terms of calcium carbonate			260
Hardness, in terms of calcium carbonate			180 Calc
Total dissolved solids			500 [illegible]
Dissolved oxygen			5.2
C.O.D.			14
5-Day B.O.D.			0.3
MB-AS			Less than 0.5
Phenols			Less than 0.05
Ammonia-nitrogen			2.1
Cyanide			Less than 0.2
Nitrite			Less than 0.1
Sulfide			Less than 0.1
Lithium			Less than 0.5

	MILLIGRAMS PER LITER
Barium	Less than 1.0
Hexavalent chromium	Less than 0.01
Arsenic	Less than 0.05
Selenium	0.012
Cadmium	Less than 0.01
Copper	Less than 0.1
Boron	4.3
Lead	Less than 0.05
Manganese	0.05
Silver	Less than 0.01
Zinc	Less than 0. 5
Mercury	Less than 0.01
Hydroxide	Less than 0.1
Residual chrloine	Less than 0.1
Beryllium	Less than 0.1
Molybdenum	Less than 0.1

pH 8.4
Turbidity 3 units

MEMBERS OF:

AMERICAN ASS'N OF CEREAL CHEMISTS
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AMERICAN OIL CHEMISTS' SOCIETY
[illegible]
[illegible]
INSTITUTE OF FOOD TECHNOLOGY
SIGMA XI

THE INDUSTRIAL LABORATORIES COMPANY
H. Paul [illegible]
CHEMIST

IS REPORT IS NOT TO BE REPRODUCED, IN WHOLE OR IN PART, FOR ADVERTISING PURPOSES WITHOUT OBTAINING PRIOR WRITTEN AUTHORIZATION

THE INDUSTRIAL LABORATORIES COMPANY

Analytical and Consulting Chemists

2600 WEST 29TH AVENUE
DENVER, COLORADO 80211

TELEPHONE 455-3641

ANALYSIS REPORT

ATLANTIC RICHFIELD COMPANY

DATE RECEIVED: 6/19/74
DATE REPORTED: 6/27/74

LAB. NUMBER: 788

SAMPLES ARE DISCARDED IN 15 DAYS FROM DATE OF REPORT UNLESS WE ARE REQUESTED, IN WRITING, TO RETAIN THEM FOR A LONGER PERIOD. PERISHABLE SAMPLES ARE USUALLY DISCARDED IMMEDIATELY UNLESS CLIENT HAS REQUESTED SPECIAL HANDLING (FREEZING, ETC.) IN ADVANCE.

SAMPLE MARKED: SG 10 1,336 Feet

ANALYSIS:

		MILLIGRAMS PER LITER	
Calcium	0.49	9.8	
Magnesium	0.80	9.6	
Sodium	7.83 9.12	180	
Carbonate	1.03	31	
Bicarbonate	8.36	510	
Chloride	0.42	15	
Sulfate	0.44 10.25	21	
Nitrate		0.56	
Phosphate		Less than 0.1	
Silicon dioxide		13	
Fluoride		8.0	
Iron		Less than 0.05	
P. alkalinity, in terms of calcium carbonate		25	
MO alkalinity, in terms of calcium carbonate		420	
Hardness, in terms of calcium carbonate		64	Calc.
Total dissolved solids		650	537
Ammonia nitrogen		1.8	
Dissolved oxygen		3.8	
5-Day B.O.D.		0.4	
C.O.D.		Less than 0.5	
Phenols		Less than 0.003	
Cyanide		Less than 0.2	
Nitrite		Less than 0.1	
Sulfide		Less than 0.1	
Lithium		Less than 0.5	
Barium		Less than 1.0	

	MILLIGRAMS PER LITER
Hexavalent chromium	Less than 0.01
Arsenic	Less than 0.05
Selenium	Less than 0.01
Cadmium	Less than 0.01
Copper	Less than 0.1
Boron	1.5
Lead	Less than 0.05
Manganese	Less than 0.05
Silver	Less than 0.01
Zinc	Less than 0.5
Mercury	Less than 0.01
Hydroxide	Less than 0.1
Residual chlorine	Less than 0.1
Beryllium	Less than 0.1
Molybdenum	Less than 0.1

pH 8.5
Turbidity 3 units

MEMBERS OF:

AMERICAN ASSN OF CEREAL CHEMISTS
AMERICAN CHEMICAL SOCIETY
AMERICAN OIL CHEMISTS' SOCIETY
[illegible]
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INSTITUTE OF FOOD TECHNOLOGY
SIGMA XI

THE INDUSTRIAL LABORATORIES COMPANY

CHEMIST

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THE INDUSTRIAL LABORATORIES COMPANY

Analytical and Consulting Chemists

2600 WEST 29TH AVENUE
DENVER, COLORADO 80211
TELEPHONE 455-3641

ANALYSIS REPORT

ATLANTIC RICHFIELD COMPANY
1500 Security Life Building
Denver, Colorado 80202

Attn: John Matis

DATE RECEIVED: 6/19/74
DATE REPORTED: 6/27/74

LAB. NUMBER: 789

SAMPLES ARE DISCARDED IN 15 DAYS FROM DATE OF REPORT UNLESS WE ARE REQUESTED, IN WRITING, TO RETAIN THEM FOR A LONGER PERIOD. PERISHABLE SAMPLES ARE USUALLY DISCARDED IMMEDIATELY UNLESS CLIENT HAS REQUESTED SPECIAL HANDLING (FREEZING, ETC.) IN ADVANCE.

SAMPLE MARKED: SG 10 1,416 Feet

ANALYSIS:

		MILLIGRAMS PER LITER	
Calcium (Ca)	0.33	6.6	
Magnesium (Mg)	1.08	13	
Sodium (Na)	10.00 11.41	230	
Carbonate (CO_3)	1.23	37	
Bicarbonate (HCO_3)	9.39	573	
Chloride (Cl)	0.39	14	
Sulfate (SO_4)	0.56 11.57	27	
Nitrate (NO_3)		0.74	
Phosphate (PO_4)		Less than 0.1	
Silicon dioxide (SiO_2)		13	
Iron (Fe)		Less than 0.05	
Fluoride (F)		18	
P. alkalinity, in terms of calcium carbonate		30	
MO alkalinity, in terms of calcium carbonate		470	
Hardness, in terms of calcium carbonate		68	Calc
Total dissolved solids		540	639
Ammonia-nitrogen		1.8	
Dissolved oxygen		3.4	
5-Day B.O.D.		0.9	
C.O.D.		4.7	
MB-AS		Less than 0.5	
Phenols		Less than 0.003	
Cyanide (Cn)		Less than 0.2	
Nitrite (NO_2)		Less than 0.1	
Sulfide		Less than 0.1	

	MILLIGRAMS PER LITER
Lithium (Li)	0.6
Barium (Ba)	Less than 1.0
Hexavalent chromium	Less than 0.01
Arsenic (As)	Less than 0.05
Selenium (Se)	Less than 0.01
Cadmium (Cd)	Less than 0.01
Copper(Cu)	Less than 0.1
Boron (B)	2.7
Manganese (Mn)	Less than 0.05
Silver (Ag)	Less than 0.01
Zinc (Zn)	Less than 0.5
Mercury (Hg)	Less than 0.01
Hydroxide (OH)	Less than 0.1
Residual chlorine	Less than 0.1
Beryllium (Be)	Less than 0.1
Molybdenum (Mo)	Less than 0.1

pH 8.5

MEMBERS OF:
AMERICAN ASS'N OF CEREAL CHEMISTS
AMERICAN CHEMICAL SOCIETY
AMERICAN OIL CHEMISTS' SOCIETY
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INSTITUTE OF FOOD TECHNOLOGY
SIGMA XI

THE INDUSTRIAL LABORATORIES COMPANY
H. Paul
CHEMIST

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THE INDUSTRIAL LABORATORIES COMPANY
Analytical and Consulting Chemists
2600 WEST 29TH AVENUE
DENVER, COLORADO 80211
TELEPHONE 455-3641

ANALYSIS REPORT

ATLANTIC RICHFIELD COMPANY

DATE RECEIVED: 7/8/74
DATE REPORTED: 8/1/74

LAB. NUMBER: 1232

SAMPLES ARE DISCARDED IN 15 DAYS FROM DATE OF REPORT UNLESS WE ARE REQUESTED, IN WRITING, TO RETAIN THEM FOR A LONGER PERIOD. PERISHABLE SAMPLES ARE USUALLY DISCARDED IMMEDIATELY UNLESS CLIENT HAS REQUESTED SPECIAL HANDLING (FREEZING, ETC.) IN ADVANCE.

SAMPLE MARKED: SG #10 - 2,211 Feet

ANALYSIS:

	MILLIGRAMS PER LITER	MILLI-EQUIVALENTS	
Calcium	16	0.80	
Magnesium	3.7	1.10	0.31
Sodium	440	19.09	19.13
Carbonate	34	1.13	
Bicarbonate	830	13.66	13.61
Chloride	120	3.38	
Sulfate	55	1.14	
Nitrate	Less than 0.1	----	
Silicon dioxide	15	0.39	
Phosphate	Less than 0.1	----	
Iron	Less than 0.05	----	
Fluoride	16	1.10	0.84
P. alkalinity, in terms of calcium carbonate	28		
MO, alkalinity, in terms of calcium carbonate	680		
Hardness, in terms of calcium carbonate	54		
Total dissolved solids	880		
Ammonia-nitrogen	7.0		
C.O.D.	11		
MB-AS	Less than 0.5		
Phenols	Less than 0.001		
Cyanide	Less than 0.01		
Nitrite	Less than 0.1		
Sulfur	Less than 0.1		
Lithium	Less than 0.5		
Barium	Less than 1.0		
Hexavalent chromium	Less than 0.01		
Arsenic	Less than 0.01		

pH 8.2

Turbidity
6 units

	MILLIGRAMS PER LITER
Selenium	Less than 0.01
Cadmium	Less than 0.01
Copper	Less than 0.1
Boron	5.0
Manganese	Less than 0.05
Silver	Less than 0.01
Zinc	Less than 0.5
Mercury	Less than 0.01
Hydroxide	Less than 0.1
Chlorine	Less than 0.1
Beryllium	Less than 0.1
Molybdenum	Less than 0.1
Lead	Less than 0.05

THE INDUSTRIAL LABORATORIES COMPANY
H. Paul Ochs
CHEMIST

MEMBERS OF:

AMERICAN ASS'N OF CEREAL CHEMISTS
AMERICAN CHEMICAL SOCIETY
AMERICAN OIL CHEMISTS' SOCIETY
ASS'N OF OFFICIAL RACING CHEMISTS
BAKERY ENGINEERS OF AMERICA
INSTITUTE OF FOOD TECHNOLOGY
SIGMA XI

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C & L LABORATORIES

Elemental Analysis — Mass Spectrometry

General Analytical Services

14335 West 44th Ave
Golden, Colo. 80401
(303) 278-9521

To: Mr. Frank Haas
The Oil Shale Corp.
18200 West Hiway 72
Golden, CO 80401

Date: 8-5-74

Analyst: S. Sweeney

Customer No.:

C & L No.: 97-057-002-11

Sample No.: TOSCO 960' depth SG #10

CONCENTRATION IN PPM WEIGHT

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium		Terbium		Ruthenium		Vanadium	0.003
Thorium		Gadolinium		Molybdenum	0.02	Titanium	0.3
Bismuth		Europium		Niobium	0.003	Scandium	0.002
Lead		Samarium		Zirconium		Calcium	*
Thallium		Neodymium		Yttrium		Potassium	*
Mercury	*	Praseodymium		Strontium	1	Chlorine	*
Gold		Cerium		Rubidium	0.006	Sulfur	*
Platinum		Lanthanum		Bromine	0.003	Phosphorus	*
Iridium		Barium	0.01	Selenium	0.001	Silicon	*
Osmium		Cesium	0.0004	Arsenic	0.01	Aluminum	0.9
Rhenium		Iodine		Germanium	0.002	Magnesium	*
Tungsten	**	Tellurium		Gallium		Sodium	*
Tantalum	**	Antimony	0.0007	Zinc	0.04	Fluorine	*
Hafnium		Tin		Copper	0.04	Oxygen	NR
Lutetium		Indium	STD	Nickel	0.01	Nitrogen	NR
Ytterbium		Cadmium		Cobalt	0.002	Carbon	NR
Thulium		Silver		Iron	0.9	Boron	
Erbium		Palladium		Manganese	0.02	Beryllium	
Holmium		Rhodium		Chromium	0.007	Lithium	*
Dysprosium						Hydrogen	NR

NR - Not Reported <0.001 ug/ml * Reported by different methods
All elements not reported ~~[illegible]~~
**Source Contamination

C & L LABORATORIES

Elemental Analysis — Mass Spectrometry

General Analytical Services

14335 West 44th Ave
Golden, Colo. 80401
(303) 278-9521

To: Mr. Frank Haas
The Oil Shale Corp.
18200 West Hiway 72
Golden, CO 80401

Date: 8-5-74

Analyst: S. Sweeney

Customer No.:

C & L No.: 97-057-002-11

Sample No.: TOSCO 1336' depth SG #10

CONCENTRATION IN PPM WEIGHT

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium		Terbium	0.001	Ruthenium		Vanadium	0.002
Thorium		Gadolinium		Molybdenum	0.009	Titanium	0.1
Bismuth		Europium		Niobium	0.002	Scandium	0.0005
Lead	0.003	Samarium		Zirconium	0.001	Calcium	*
Thallium		Neodymium		Yttrium	0.0006	Potassium	*
Mercury	*	Praseodymium		Strontium	0.1	Chlorine	*
Gold		Cerium	0.001	Rubidium	0.008	Sulfur	*
Platinum		Lanthanum	0.0009	Bromine	0.01	Phosphorus	*
Iridium		Barium	0.02	Selenium	0.02	Silicon	*
Osmium		Cesium	0.003	Arsenic	0.005	Aluminum	2
Rhenium		Iodine	0.0009	Germanium	0.005	Magnesium	*
Tungsten	**	Tellurium		Gallium	0.002	Sodium	*
Tantalum	**	Antimony	0.005	Zinc	0.009	Fluorine	*
Hafnium		Tin		Copper	0.006	Oxygen	NR
Lutetium		Indium	STD	Nickel	0.01	Nitrogen	NR
Ytterbium		Cadmium	0.003	Cobalt	0.04	Carbon	NR
Thulium		Silver	0.005	Iron	0.2	Boron	
Erbium		Palladium		Manganese	0.004	Beryllium	
Holmium		Rhodium		Chromium	0.001	Lithium	*
Dysprosium						Hydrogen	NR

NR - Not Reported

All elements not reported <0.001 μg/ml [illegible]

**Source Contamination

*Reported by different methods

C & L LABORATORIES

Elemental Analysis — Mass Spectrometry

General Analytical Services

14335 West 44th Ave
Golden, Colo. 80401
(303) 278-9521

August 8, 1974

Mr. Frank Haas
The Oil Shale Corp.
18200 W. Hiway 72
Golden, CO 80401

Dear Mr. Haas:

These are corrected results from analysis of water samples a) Arco 6-17-74 SG #10 960' b) Arco 6-17-74 SG #10 1336', and c) Arco 6-17-74 SG #10 1416', assigned C & L #97-057-002-11.

	mg/L	
Footage	SO_4	Bicarbonate Alkalinity as $CaCO_3$
960	150	550
1336	25	840
1416	24	910

If you have any further questions regarding the analysis or procedures, please don't hesitate to call.

S. Sweeney

S. Sweeney, Analyst

jj

C & L LABORATORIES
Elemental Analysis — Mass Spectrometry

General Analytical Services

14335 West 44th Ave
Golden, Colo. 80401
(303) 278-9521

July 17, 1974

Mr. Frank Haas
The Oil Shale Corp.
18200 W. Hiway 72
Golden, CO 80401

ANALYTICAL REPORT

Partial analysis, of water samples a) Arco 6-17-74 SG #10 960', b) Arco 6-17-74 SG #10 1336' and c) Arco 6-17-74 SG #10 1416', received June 19, 1974, and assigned C & L #97-057-002-11. Samples are referred to by their footage numbers. Each sample received was in six portions, one untreated marked regular, and the remaining five were pretreated by you and labled BOD, Hg for N, CN + NaOH, Phenol + CU - Acid, and Metal & Acid. All tests were run on the untreated (Regular) sample unless otherwise stated.

ANALYSIS

	μg/ml						
Footage	Na	Ca	K	Mg	Li	Si	F
960	140	46	0.39	.18	<0.05	16	3.3
1336	190	14	0.65	4.0	<0.05	5.0	14
1416	215	13	0.47	4.0	<0.05	5.0	14

	pCi/L	
Footage	α*	β*
960	2.9 ± 1.9	0 ± 10
1336	9.2 ± 2.7	0 ± 12
1416	1.4 ± 1.4	0 ± 11

	mg/L			
Footage	COD	TOC*	Cl	SO_4
960	2.9	0.7	4.4	0.15
1336	<0.4	0.7	3.0	0.03
1416	18	31	0.5	0.02

* Outside Lab

Footage	mg/L Carbonate Alkalinity as $CaCO_3$	Bicarbonate Alkalinity as $CaCO_3$
960	21	1140
1336	28	1710
1416	28	1870

Footage	g/L Dissolved Solids	Suspended Solids	Oil & Grease**
960	0.46	0.09	0.001
1336	0.45	0.07	0.023
1416	0.44	0.11	0.027

**Sample should have been collected in a glass bottle, at least one liter in volume, and preserved with 2 ml H_2SO_4/liter.

Five Day BOD Analysis - Performed on sample portion marked BOD

Footage	mg/L
960	12.5
1336	12.5
1416	12.5

CN Analysis - Performed on sample portion marked CN + NaOH

Footage	µg/ml
960	<0.05
1336	<0.05
1416	<0.05

Phenol Analysis - Performed on sample portion marked Phenol + Cu - Acid

Footage	µg/ml
960	<0.05
1336	<0.05
1416	<0.05

Free NH_3 Analysis - Performed on sample portion marked Hg for N

Footage	μg/ml
960	0.27
1336	0.77
1416	0.65

PO_4 Analysis - Performed on sample portion marked Hg for N

Footage	mg/L P
960	20
1336	<10
1416	<10

Footage	Coliform***	Fecal Coliform***	pH	Color
960	negative	negative	8.31	2
1336	negative	negative	8.44	6
1416	negative	10,000 colonies per 100 ml	8.31	10

***Analysis performed on regular water samples

The remainder of the water analysis including the spark source elemental analysis should be reported shortly. If you have any questions regarding the analysis or procedures, please don't hesitate to call.

S Sweeney
S. Sweeney, Analyst

M L Jacobs
Approved: M. L. Jacobs

cj

The following are a continuation of completed analysis from C & L #97-057-002-11, your sample numbers a) Arco 6-17-74, SG #10 960', b) Arco 6-17-74 SG #10 1336' and c) Arco 6-17-74 SG #10 1416'.

Hg - Performed on sample portion marked "Regular"

Footage	µg/ml Hg
960	0.0001
1336	0.0003
1416	0.0001

Nitrite & Nitrate - Performed on sample portion marked Hg for N

	µg/L N	
Footage	Nitrate	Nitrite
960	50	<5
1336	60	<5
1416	80	<5

Please note correction on Phosphate Results, µg/L not mg/L

PO_4 - Performed on sample portion marked Hg for M

Footage	µg/L P
960	20
1336	<10
1416	<10

Odor Threshold* - Performed on sample portion marked "Regular"

Footage	Threshold
960	0
1336	0
1416	4

*Sample should have been collected in glass bottle.

If you have any questions on these analyses, please feel free to call.

S. Sweeney

S. Sweeney, Analyst

SS/cj

WATER QUALITY ANALYSES

SG - 11

TRACT C-b

TABLE 1

MAJOR CONSTITUENT ANALYSES, CORE HOLE SG-11

Element, mg/l	808.1-Feet		868-Feet		1330-Feet		1385-Feet		2465-Feet		2825-Feet	
	Industrial	TOSCO	Industrial	TOSCO	Industrial	TOSCO	Industrial	TOSCO	Industrial	TOSCO	Industrial	TOSCO
Na	163	165	160	141	220	215	240	211	295	488	355	500
K	NA	0.6	NA	0.8	NA	1.3	NA	1.2	NA	1.5	NA	1.8
Ca	62	59	41	33	100	89	26	26	12	18	23	36
Mg	47	43	36	33	79	78	18	18	9	15	14	28
SO_4	250	316	190	202	455	433	120	86	75	56	195	199
CO_3	36	9	40	8	<0.1	2	<0.1	14	40	26	43	43
HCO_3	430	441	370	383	630	620	590	564	570	1036	520	973
Cl	21	8	23	6	28	5	21	3	62	101	115	68
F	0.8	0.4	1.6	1.6	4.0	4.4	11	12	16	14	12	10
Σ Cations, meq/l	14.05	13.68	11.96	10.52	21.07	20.25	13.21	11.99	14.23	23.39	17.76	25.69
Σ Anions, meq/l	14.07	14.34	12.00	11.01	20.58	19.62	12.94	12.22	14.83	22.60	17.89	23.97
% Difference	0.1	2.3	0.1	2.2	1.2	0.9	1.0	0.9	2.1	1.7	0.4	3.8
Silica, mg/l	23	24	22	21	28	19	16	11	16	17	19	19
pH	7.8	8.4	8.0	8.4	7.9	8.2	7.5	8.5	8.0	8.6	8.0	8.6
Calculated TDS, mg/l	814	841	695	634	1223	1150	741	659	804	1244	1030	1382
Measured TDS, mg/l	860	NA	650	NA	1350	NA	720	NA	1320	NA	1530	NA

THE INDUSTRIAL LABORATORIES COMPANY

Analytical and Consulting Chemists

2600 WEST 29TH AVENUE
DENVER, COLORADO 80211
TELEPHONE 455-3641

ANALYSIS REPORT

ATLANTIC RICHFIELD COMPANY
1500 Security Life Building.
Denver, Colorado 80202

Attn: Don Tait

DATE RECEIVED: 8/3/74
DATE REPORTED: 8/9/74

LAB. NUMBER: 1864-1

SAMPLES ARE DISCARDED IN 15 DAYS FROM DATE OF REPORT UNLESS WE ARE REQUESTED, IN WRITING, TO RETAIN THEM FOR A LONGER PERIOD. PERISHABLE SAMPLES ARE USUALLY DISCARDED IMMEDIATELY UNLESS CLIENT HAS REQUESTED SPECIAL HANDLING (FREEZING, ETC.) IN ADVANCE.

SAMPLE MARKED: Water SG #11 286.6 Feed 7/24/74

ANALYSIS:

	MILLIGRAMS PER LITER	MILLI-EQUIVALENTS
Calcium (Ca)	120	5.988
Magnesium (Mg)	90	7.407
Sodium (Na)	220	9.440
Carbonate (CO_3)	24	0.799
Bicarbonate (HCO_3)	360	5.904
Chloride (Cl)	31	0.874
Sulfate (SO_4)	690	14.352
Nitrate (NO_3)	Less than 0.1	-----
Phosphate (PO_4)	Less than 0.1	-----
Silicon dioxide	34	0.894
Iron (Fe)	0.16	
Fluoride (F)	Less than 0.1	
P. alkalinity, in terms of calcium carbonate	20	
MO alkalinity, in terms of calcium carbonate	295	
Hardness, in terms of calcium carbonate	670	
Total dissolved solids (by evaporation)	1,380	

Σ cations = [illegible]
Σ anions = 21.[illegible]
% Diff. = [illegible]

pH 7.0
Specific conductance 1,810 micromhos per cc

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THE INDUSTRIAL LABORATORIES COMPANY
J. Paul Ochs
CHEMIST

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ANALYSIS REPORT

ATLANTIC RICHFIELD COMPANY

DATE RECEIVED: 8/3/74
DATE REPORTED: 8/9/74

LAB. NUMBER: 1864-2

SAMPLES ARE DISCARDED IN 15 DAYS FROM DATE OF REPORT UNLESS WE ARE REQUESTED, IN WRITING, TO RETAIN THEM FOR A LONGER PERIOD. PERISHABLE SAMPLES ARE USUALLY DISCARDED IMMEDIATELY UNLESS CLIENT HAS REQUESTED SPECIAL HANDLING (FREEZING, ETC.) IN ADVANCE.

SAMPLE MARKED: Water SG #11 336.6 Feet 7/24/74

ANALYSIS:

	MILLIGRAMS PER LITER	MILLI-EQUIVALENTS	
Calcium	130	6.587	6.500
Magnesium	94	7.736	
Sodium	240	10.527	10.435
Carbonate	24	0.799	
Bicarbonate	360	5.904	
Chloride	35	0.987	
Sulfate	780	16.224	
Nitrate	Less than 0.1	-----	
Phosphate	Less than 0.1	-----	
Silicon dioxide	35	0.921	
Iron	0.14	-----	
Fluoride	Less than 0.1	-----	
P. alkalinity, in terms of calcium carbonate	20		
MO alkalinity, in terms of calcium carbonate	295		
Hardness, in terms of calcium carbonate	715		
Total dissolved solids (by evaporation)	1,490		

Σ cations = 24.67
Σ anions = 23.91
% Diff = 1.6

pH 8.0
Specific conductance 1,870 micromhos per cc

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ANALYSIS REPORT

ATLANTIC RICHFIELD COMPANY

DATE RECEIVED: 8/3/74
DATE REPORTED: 8/9/74

LAB. NUMBER: 1864-3

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SAMPLE MARKED: Water SG #11 7/24/74 386.6 Feet

ANALYSIS:

	MILLIGRAMS PER LITER	MILLI-EQUIVALENTS	
Calcium	130	6.437	6.500
Magnesium	110	8.971	9.053
Sodium	240	10.483	10.435
Carbonate	24	0.799	
Bicarbonate	410	6.724	
Chloride	42	1.179	
Sulfate	770	16.016	16.042
Nitrate	Less than 0.1	------	
Phosphate	Less than 0.1	------	
Silicon dioxide	45	1.183	
Iron	0.05	------	
Fluoride	Less than 0.1	------	
P. alkalinity, in terms of calcium carbonate	20		
MO alkalinity, in terms of calcium carbonate	335		
Hardness, in terms of calcium carbonate	770		
Total dissolved solids (by evaporation)	1,550		

Σ Cations = 25.99
Σ Anions = [illegible]
% Diff. = 2.5

pH 7.9
Specific conductance 1,960 micromhos per cc

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DATE RECEIVED: 8/3/74
DATE REPORTED: 8/9/74

LAB. NUMBER: 1864-4

SAMPLES ARE DISCARDED IN 15 DAYS FROM DATE OF REPORT UNLESS WE ARE REQUESTED, IN WRITING, TO RETAIN THEM FOR A LONGER PERIOD. PERISHABLE SAMPLES ARE USUALLY DISCARDED IMMEDIATELY UNLESS CLIENT HAS REQUESTED SPECIAL HANDLING (FREEZING, ETC.) IN ADVANCE.

SAMPLE MARKED: Water SG #11 436.6 Feet 7/24/74

ANALYSIS:

	MILLIGRAMS PER LITER	MILLI-EQUIVALENTS	
Calcium	100	5.090	5.09
Magnesium	130	10.370	10.70
Sodium	240	10.266	10.43
Carbonate	23	0.766	
Bicarbonate	500	8.134	8.20
Chloride	35	0.981	
Sulfate	730	15.184	
Nitrate	0.1	----	
Phosphate	Less than 0.1	----	
Silicon dioxide	26	0.684	
Iron	0.10	----	
Fluoride	Less than 0.1		
P. alkalinity, in terms of calcium carbonate	19		
MO alkalinity, in terms of calcium carbonate	410		
Hardness, in terms of calcium carbonate	770		
Total dissolved solids (by evaporation)	1,620		

Σ Cations = 26.22
Σ Anions = 25.13
% Diff. = 1.9

pH 7.9
Specific conductance 1,990 micromhos per cc

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ATLANTIC RICHFIELD COMPANY

DATE RECEIVED:	8/3/74
DATE REPORTED:	8/9/74
LAB. NUMBER:	1864-5

SAMPLES ARE DISCARDED IN 15 DAYS FROM DATE OF REPORT UNLESS WE ARE REQUESTED, IN WRITING, TO RETAIN THEM FOR A LONGER PERIOD. PERISHABLE SAMPLES ARE USUALLY DISCARDED IMMEDIATELY UNLESS CLIENT HAS REQUESTED SPECIAL HANDLING (FREEZING, ETC.) IN ADVANCE.

SAMPLE MARKED: Water SG #11 486.6 Feet 7/24/74

ANALYSIS:

	MILLIGRAMS PER LITER	MILLI-EQUIVALENTS
Calcium	98	4.890
Magnesium	105	8.806
Sodium	275	11.919
Carbonate	32	1.066
Bicarbonate	570	9.332
Chloride	35	0.981
Sulfate	650	13.520
Nitrate	0.1	----
Phosphate	Less than 0.1	----
Silicon dioxide	23	0.605
Iron	0.05	
Fluoride	Less than 0.1	
P. alkalinity, in terms of calcium carbonate	26	
MO alkalinity, in terms of calcium carbonate	470	
Hardness, in terms of calcium carbonate	685	
Total dissolved solids	1,700	

Σ Cations : 25.49
Σ anions : 24.95
% Diff : 1.2

pH 7.8
Specific conductance 1,870 micromhos per cc

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ATLANTIC RICHFIELD

DATE RECEIVED: 8/3/74
DATE REPORTED: 8/9/74

LAB. NUMBER: 1864-6

SAMPLES ARE DISCARDED IN 15 DAYS FROM DATE OF REPORT UNLESS WE ARE REQUESTED, IN WRITING, TO RETAIN THEM FOR A LONGER PERIOD. PERISHABLE SAMPLES ARE USUALLY DISCARDED IMMEDIATELY UNLESS CLIENT HAS REQUESTED SPECIAL HANDLING (FREEZING, ETC.) IN ADVANCE.

SAMPLE MARKED: Water SG #11 536.6 Feet 7/24/74

ANALYSIS:

	MILLIGRAMS PER LITER	MILLI-EQUIVALENTS	
Calcium	88	6.138	[illegible]
Magnesium	110	9.300	9.553
Sodium	220	9.483	9.565
Carbonate	30	0.999	
Bicarbonate	590	9.725	[illegible]
Chloride	42	1.179	
Sulfate	585	12.168	
Nitrate	Less than 0.1	----	
Phosphate	Less than 0.1	----	
Silicon dioxide	32	0.842	
Iron	Less than 0.05	----	
Fluoride	Less than 0.1		
P. alkalinity, in terms of calcium carbonate	25		Σ [illegible]
MO alkalinity, in terms of calcium carbonate	490		Σ [illegible]
Hardness, in terms of calcium carbonate	680		[illegible]
Total dissolved solids	1,530		

pH 8.0
Specific conductance 1,840 micromhos per cc

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H. Paul [illegible]
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ATLANTIC RICHFIELD COMPANY

DATE RECEIVED: 8/3/74
DATE REPORTED: 8/9/74

LAB. NUMBER: 1864-7

SAMPLES ARE DISCARDED IN 15 DAYS FROM DATE OF REPORT UNLESS WE ARE REQUESTED, IN WRITING, TO RETAIN THEM FOR A LONGER PERIOD. PERISHABLE SAMPLES ARE USUALLY DISCARDED IMMEDIATELY UNLESS CLIENT HAS REQUESTED SPECIAL HANDLING (FREEZING, ETC.) IN ADVANCE.

SAMPLE MARKED: SG #11 Water 586.6 Feet 7/24/74

ANALYSIS:

	MILLIGRAMS PER LITER	MILLI-EQUIVALENTS	
Calcium	125	6.138	6.238
Magnesium	88	7.242	11.304
Sodium	260	11.343	
Carbonate	24	0.799	
Bicarbonate	560	9.233	
Chloride	49	1.382	
Sulfate	610	12.688	12.707
Nitrate	0.2	----	
Phosphate	Less than 0.1	----	
Silicon dioxide	24	0.631	
Iron	Less than 0.05		
Fluoride	Less than 0.1		
P. alkalinity, in terms of calcium carbonate	20		
MO alkalinity, in terms of calcium carbonate	485		
Hardness, in terms of calcium carbonate	670		
Total dissolved solids (by evaporation)	1,570		

Σ Cations = 24.78
Σ Anions = 24.07
% Diff = 1.5

pH 7.8
Specific conductance 1,850 micromhos per cc

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ANALYSIS REPORT

ATLANTIC RICHFIELD COMPANY

DATE RECEIVED: 8/3/74
DATE REPORTED: 8/9/74

LAB. NUMBER: 1864-8

SAMPLES ARE DISCARDED IN 15 DAYS FROM DATE OF REPORT UNLESS WE ARE REQUESTED, IN WRITING, TO RETAIN THEM FOR A LONGER PERIOD. PERISHABLE SAMPLES ARE USUALLY DISCARDED IMMEDIATELY UNLESS CLIENT HAS REQUESTED SPECIAL HANDLING (FREEZING, ETC.) IN ADVANCE.

SAMPLE MARKED: SG #11 Water 636.6 Feet 7/24/74

ANALYSIS:

	MILLIGRAMS PER LITER	MILLI-EQUIVALENTS	
Calcium	89	4.441	
Magnesium	86	7.078	
Sodium	230	10.048	
Carbonate	48	1.598	
Bicarbonate	530	8.626	8.[illegible]
Chloride	32	0.784	0.90[illegible]
Sulfate	480	9.984	10.[illegible]
Nitrate	0.1	----	
Phosphate	Less than 0.1	----	
Silicon dioxide	22	0.579	
Iron	Less than 0.05		
Fluoride	Less than 0.1		
P. alkalinity, in terms of calcium carbonate	39		
MO alkalinity, in terms of calcium carbonate	430		
Hardness, in terms of calcium carbonate	575		
Total dissolved solids (by evaporation)	1,290		

Σ Cations = 21.52
Σ Anions = 21.19
% Diff. = 0.7

pH 8.0
Specific conductance 1,740 micromhos per cc

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ANALYSIS REPORT

ATLANTIC RICHFIELD COMPANY

DATE RECEIVED: 8/3/74
DATE REPORTED: 8/9/74

LAB. NUMBER: 1864-9

SAMPLES ARE DISCARDED IN 15 DAYS FROM DATE OF REPORT UNLESS WE ARE REQUESTED, IN WRITING, TO RETAIN THEM FOR A LONGER PERIOD. PERISHABLE SAMPLES ARE USUALLY DISCARDED IMMEDIATELY UNLESS CLIENT HAS REQUESTED SPECIAL HANDLING (FREEZING, ETC.) IN ADVANCE.

SAMPLE MARKED: Water SG #11 686.6 Feet 7/24/74

ANALYSIS:

	MILLIGRAMS PER LITER	MILLI-EQUIVALENTS	
Calcium	67	3.433	[illegible]
Magnesium	75	6.172	
Sodium	250	10.911	[illegible]
Carbonate	42	1.399	[illegible]
Bicarbonate	480	7.839	
Chloride	35	0.987	
Sulfate	450	9.360	
Nitate	0.2	----	
Phosphate	Less than 0.1	----	
Silicon dioxide	32	0.842	
Iron	Less than 0.05		
Fluoride	Less than 0.1		
P. alkalinity, in terms of calcium carbonate	34		
MO alkalinity, in terms of calcium carbonate	390		
Hardness, in terms of calcium carbonate	475		
Total dissolved solids (by evaporation)	1,170		

Σ Cations = 20.3[illegible]
Σ anions = 19.6[illegible]
[illegible] = 1.9

pH 8.0
Specific conductance 1,610 micromhos per cc

MEMBERS OF:
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H. Paul [illegible]
CHEMIST

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DENVER, COLORADO 80211
ANALYSIS REPORT

TELEPHONE 455-3641

ATLANTIC RICHFIELD COMPANY

DATE RECEIVED: 8/3/74
DATE REPORTED: 8/9/74

LAB. NUMBER: 1864-10

SAMPLES ARE DISCARDED IN 15 DAYS FROM DATE OF REPORT UNLESS WE ARE REQUESTED, IN WRITING, TO RETAIN THEM FOR A LONGER PERIOD. PERISHABLE SAMPLES ARE USUALLY DISCARDED IMMEDIATELY UNLESS CLIENT HAS REQUESTED SPECIAL HANDLING (FREEZING, ETC.) IN ADVANCE.

SAMPLE MARKED: Water SG #11 737.1 Feet 7/25/74

ANALYSIS:

	MILLIGRAMS PER LITER	MILLI-EQUIVALENTS
Calcium	57	2.844
Magnesium	48	3.950
Sodium	230	10.092
Carbonate	30	0.999
Bicarbonate	420	6.839
Chloride	28	0.784
Sulfate	360	7.488
Nitrate	0.1	----
Phosphate	Less than 0.1	----
Silicon dioxide	30	0.789
Iron	Less than 0.05	
Fluoride	0.1	
P. alkalinity, in terms of calcium carbonate	25	
MO alkalinity, in terms of calcium carbonate	340	
Hardness, in terms of calcium carbonate	340	
Total dissolved solids (by evaporation)	980	

Σ cations = 16.[illegible]
Σ anions = [illegible]
[illegible] = 1.9

pH 8.1
Specific conductance 1,340 micromhos per cc

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ANALYSIS REPORT

DATE RECEIVED: 8/3/74
DATE REPORTED: 8/9/74

ATLANTIC RICHFIELD COMPANY

LAB. NUMBER: 1864-11

SAMPLES ARE DISCARDED IN 15 DAYS FROM DATE OF REPORT UNLESS WE ARE REQUESTED, IN WRITING, TO RETAIN THEM FOR A LONGER PERIOD. PERISHABLE SAMPLES ARE USUALLY DISCARDED IMMEDIATELY UNLESS CLIENT HAS REQUESTED SPECIAL HANDLING (FREEZING, ETC.) IN ADVANCE.

SAMPLE MARKED: Water SG #11 786.5 Feet 7/25/74

ANALYSIS:	MILLIGRAMS PER LITER	MILLI-EQUIVALENTS
Calcium	34	1.697
Magnesium	48	3.950
Sodium	190	8.265
Carbonate	40	1.332
Bicarbonate	360	5.904
Chloride	35	0.987
Sulfate	240	4.992
Nitrate	0.1	----
Phosphate	Less than 0.1	----
Silicon dioxide	26	0.684
Iron	Less than 0.05	
Fluoride	0.6	
P. alkalinity, in terms of calcium carbonate	33	
MO alkalinity, in terms of calcium carbonate	295	
Hardness, in terms of calcium carbonate	280	
Total dissolved solids	870	

Σ Cations = 13.91
Σ Anions : 13.22
% Diff. : 2.5

pH 8.2
Specific conductance 1,140 micromhos per cc

THE INDUSTRIAL LABORATORIES COMPANY
CHEMIST

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THE INDUSTRIAL LABORATORIES COMPANY

Analytical and Consulting Chemists

2600 WEST 29TH AVENUE
DENVER, COLORADO 80211
TELEPHONE 455-3641

ANALYSIS REPORT

ATLANTIC RICHFIELD COMPANY
1500 Security Life Building
Denver, Colorado 80202

Attn: Don Tait

DATE RECEIVED: 8/2/74
DATE REPORTED: 8/7/74

LAB. NUMBER: 1842

SAMPLES ARE DISCARDED IN 15 DAYS FROM DATE OF REPORT UNLESS WE ARE REQUESTED, IN WRITING, TO RETAIN THEM FOR A LONGER PERIOD. PERISHABLE SAMPLES ARE USUALLY DISCARDED IMMEDIATELY UNLESS CLIENT HAS REQUESTED SPECIAL HANDLING (FREEZING, ETC.) IN ADVANCE.

SAMPLE MARKED: S.G. #11 808.1' 7/27

ANALYSIS:

	MILLIGRAMS PER LITER		MILLI-EQUIVALENTS	
Calcium (Ca)	62		3.09	
Magnesium (Mg)	47	Σ cations = 14.05	3.87	
Sodium (Na)	163	Σ anions = 14.07	7.69	7.09
Carbonate (CO_3)	36	[illegible] = 0.07	1.20	
Bicarbonate (HCO_3)	430		7.05	
Chloride (Cl)	21		0.59	
Sulfate (SO_4)	250		5.20	
Nitrate (NO_3)	1.7		0.60	0.03
Phosphate (PO_4)	Less than 0.1			
Silicon dioxide (SiO_2)	23			
Fluoride (F)	0.8			
Iron (Fe)	Less than 0.05			
P. alkalinity, in terms of calcium carbonate	29			
MO alkalinity, in terms of calcium carbonate	350			
Hardness, in terms of calcium carbonate	350			
Phenols	0.005			
Cyanide (Cn)	Less than 0.01			
Nitrite (NO_2)	Less than 0.1			
Sulfur (S)	Less than 0.05			
Lithium (Li)	Less than 1.0			
Beryllium (Be)	Less than 1.0			
Hexavalent chromium	Less than 0.01			
Arsenic (As)	Less than 0.01			
Selenium (Se)	Less than 0.01			
Cadmium (Cd)	Less than 0.01			

pH 7.8

Turbidity
Less than 1 unit

	MILLIGRAMS PER LITER
Mercury (Hg)	Less than 0.01
Copper (Cu)	Less than 0.1
Boron (B)	Less than 0.1
Lead (Pb)	Less than 0.05
Manganese (Mn)	Less than 0.05
Silver (Ag)	Less than 0.01
Zinc (Zn)	Less than 0.5
Hydroxide (OH)	Less than 0.1
Residual chlorine	Less than 0.1
Molybdenum (Mo)	Less than 0.1
Barium (Ba)	Less than 1.0
Ttotal dissolved solids	860

THE INDUSTRIAL LABORATORIES COMPANY
Paul Ocla
CHEMIST

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ANALYSIS REPORT

ATLANTIC RICHFIELD COMPANY

DATE RECEIVED: 8/3/74
DATE REPORTED: 8/9/74

LAB. NUMBER: 1864-12

SAMPLES ARE DISCARDED IN 15 DAYS FROM DATE OF REPORT UNLESS WE ARE REQUESTED, IN WRITING, TO RETAIN THEM FOR A LONGER PERIOD. PERISHABLE SAMPLES ARE USUALLY DISCARDED IMMEDIATELY UNLESS CLIENT HAS REQUESTED SPECIAL HANDLING (FREEZING, ETC.) IN ADVANCE.

SAMPLE MARKED: Water SG #11 836.6 Feet 7/27/74

ANALYSIS:

	MILLIGRAMS PER LITER	MILLI-EQUIVALENTS	
Calcium	89	2.695	[illegible]
Magnesium	86	3.539	[illegible]
Sodium	230	8.178	[illegible]
Carbonate	48	1.532	[illegible]
Bicarbonate	525	6.347	[illegible]
Chloride	31	0.790	0.873
Sulfate	48	4.992	[illegible]
Nitrate	0.1	----	
Phosphate	Less than 0.1	----	
Silicon dioxide	22	0.657	
Iron	Less than 0.05		
Fluoride	Less than 0.1		
P. alkalinity, in terms of calcium carbonate	39		
MO alkalinity, in terms of calcium carbonate	430		
Hardness, in terms of calcium carbonate	575		
Total dissolved solids (by evaporation)	900		

Σ [illegible] : 21.53
Σ [illegible] : 12.68
[illegible] : 25.1

pH 8.0
Specific conductance 1,160 micromhos per cc

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H. Paul Ochs
CHEMIST

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ANALYSIS REPORT

ATLANTIC RICHFIELD

DATE RECEIVED: 8/2/74
DATE REPORTED: 8/7/74

LAB. NUMBER: 1843

SAMPLES ARE DISCARDED IN 15 DAYS FROM DATE OF REPORT UNLESS WE ARE REQUESTED, IN WRITING, TO RETAIN THEM FOR A LONGER PERIOD. PERISHABLE SAMPLES ARE USUALLY DISCARDED IMMEDIATELY UNLESS CLIENT HAS REQUESTED SPECIAL HANDLING (FREEZING, ETC.) IN ADVANCE.

SAMPLE MARKED: S.G. #11 868.0 Feet 7/27/74

ANALYSIS:

	MILLIGRAMS PER LITER		MILLI-EQUIVALENTS	
Calcium	41		2.04	
Magnesium	36		2.96	
Sodium	160	Σ cations = 11.96	7.57	6.96
Carbonate	40	Σ anions = 12.58	1.33	
Bicarbonate	370	% D.H = 0.1	6.07	
Chloride	23		0.65	
Sulfate	190		3.95	
Silicon dioxide	22		0.58	
Nitrate	3.5			
Phosphate	Less than 0.1			

pH	8.0
Turbidity	Less than 1 unit

Fluoride	1.6
Iron	Less than 0.05
P. alkalinity, in terms of calcium carbonate	33
MO alkalinity, in terms of calcium carbonate	300
Hardness, in terms of calcium carbonate	250
Phenols	Less than 0.001
Cyanide	Less than 0.01
Nitrite	Less than 0.1
Sulfur	Less than 0.05
Lithium	Less than 1.0
Barium	Less than 1.0
Ammonia-nitrogen	0.9
Hexavalent chromium	Less than 0.01
Arsenic	Less than 0.01
Selenium	Less than 0.01

	MILLIGRAMS PER LITER
Cadmium	Less than 0.01
Copper	Less than 0.01
Boron	Less than 0.1
Lead	Less than 0.05
Manganese	Less than 0.05
Silver	Less than 0.01
Zinc	Less than 0.5
Mercury	Less than 0.01
Hydroxide	Less than 0.1
Residual chlorine	Less than 0.1
Molybdenum	Less than 0.1
Beryllium	Less than 0.1
Total dissolved solids	650

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J. Paul [illegible]
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ATLANTIC RICHFIELD COMPANY

DATE RECEIVED: 8/3/74
DATE REPORTED: 8/9/74

LAB. NUMBER: 1864-13

SAMPLES ARE DISCARDED IN 15 DAYS FROM DATE OF REPORT UNLESS WE ARE REQUESTED, IN WRITING, TO RETAIN THEM FOR A LONGER PERIOD. PERISHABLE SAMPLES ARE USUALLY DISCARDED IMMEDIATELY UNLESS CLIENT HAS REQUESTED SPECIAL HANDLING (FREEZING, ETC.) IN ADVANCE.

SAMPLE MARKED: Water SG #11 885 Feet 7/27/74

ANALYSIS:

	MILLIGRAMS PER LITER	MILLI-EQUIVALENTS
Calcium	29	1.447
Magnesium	46	3.786
Sodium	175	7.656 7.608
Carbonate	Less than 0.1	----
Bicarbonate	400 ✓	6.544
Chloride	42	1.184
Sulfate	225 ✓	4.680
Nitrate	0.1	----
Phosphate	Less than 0.1	----
Silicon dioxide	18	0.473
Iron	0.16	
Fluoride	2.8	
P. alkalinity, in terms of calcium carbonate	Less than 0.1	
MO alkalinity, in terms of calcium carbonate	330	
Hardness, in terms of calcium carbonate	260	
Total dissolved solids (by evaporation)	810	

Σ cations = 12.5
Σ anions = 12.9
% diff = 1.7

pH 7.9
Specific conductance 1,140 micromhos per cc

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H. Paul Ochs
CHEMIST

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ATLANTIC RICHFIELD COMPANY

DATE RECEIVED: 8/3/74
DATE REPORTED: 8/9/74

LAB. NUMBER: 1864-14

SAMPLES ARE DISCARDED IN 15 DAYS FROM DATE OF REPORT UNLESS WE ARE REQUESTED, IN WRITING, TO RETAIN THEM FOR A LONGER PERIOD. PERISHABLE SAMPLES ARE USUALLY DISCARDED IMMEDIATELY UNLESS CLIENT HAS REQUESTED SPECIAL HANDLING (FREEZING, ETC.) IN ADVANCE.

SAMPLE MARKED: Water SG #11 925 Feet 7/28/74

ANALYSIS:

	MILLIGRAMS PER LITER	MILLI-EQUIVALENTS
Calcium	19	0.948
Magnesium	49	4.033
Sodium	165	7.090
Carbonate	22	0.733
Bicarbonate	395	6.445
Chloride	21	0.592
Sulfate	185	3.890
Nitrate	0.1	----
Phosphate	Less than 0.1	----
Silicon dioxide	15	0.395
Iron	0.18	
Fluoride	4.6	
P. alkalinity, in terms of calcium carbonate	18	
MO alkalinity, in terms of calcium carbonate	320	
Hardness, in terms of calcium carbonate	250	
Total dissolved solids	760	

Σ cations 12.07
Σ anions = 11.66
% [illegible] = 1.7

pH 8.1
Specific conductance 1,050 micromhos per cc

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ATLANTIC RICHFIELD COMPANY

DATE RECEIVED: 8/3/74
DATE REPORTED: 8/9/74

LAB. NUMBER: 1864-15

SAMPLES ARE DISCARDED IN 15 DAYS FROM DATE OF REPORT UNLESS WE ARE REQUESTED, IN WRITING, TO RETAIN THEM FOR A LONGER PERIOD. PERISHABLE SAMPLES ARE USUALLY DISCARDED IMMEDIATELY UNLESS CLIENT HAS REQUESTED SPECIAL HANDLING (FREEZING, ETC.) IN ADVANCE.

975!

SAMPLE MARKED: Water SG #11 925 Feet 7/29/74

ANALYSIS:

	MILLIGRAMS PER LITER	MILLI-EQUIVALENTS	
Calcium	9.8	0.489	
Magnesium	33	2.716	
Sodium	160	7.039	6.951
Carbonate	24	0.799	
Bicarbonate	365	6.002	5.983
Chloride	28	0.784	
Sulfate	100	2.080	
Nitrate	0.1	----	
Phosphate	Less than 0.1	----	
Silicon dioxide	22	0.579	
Iron	0.32		
Fluoride	1.2		
P. alklalinity, in terms of calcium carbonate	20		
MO alkalinity, in terms of calcium carbonate	300		
Hardness, in terms of calcium carbonate	160		
Total dissolved solids (by evaporation)	580		

Σ cations = 10.16
Σ anions = 9.65
% Diff = 2.6

pH 8.2
Specific conductance 860 micromhos per cc

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TELEPHONE 455-3641

ANALYSIS REPORT

DATE RECEIVED: 8/9/74
DATE REPORTED: 8/16/74

ATLANTIC RICHFIELD COMPANY

LAB. NUMBER: 2012-3

SAMPLES ARE DISCARDED IN 15 DAYS FROM DATE OF REPORT UNLESS WE ARE REQUESTED, IN WRITING, TO RETAIN THEM FOR A LONGER PERIOD. PERISHABLE SAMPLES ARE USUALLY DISCARDED IMMEDIATELY UNLESS CLIENT HAS REQUESTED SPECIAL HANDLING (FREEZING, ETC.) IN ADVANCE.

SAMPLE MARKED: GG #11 7/29/74 1,025 Feet

ANALYSIS:	MILLIGRAMS PER LITER	MILLI-EQUIVALENTS
Calcium	25	1.247
Magnesium	26	2.140
Sodium	155	6.743
Carbonate	Less than 0.1	-----
Bicarbonate	410	6.724
Chloride	24	0.677
Sulfate	125	2.579
Nitrate	0.4	-----
Phosphate	Less than 0.1	-----
Silicon dioxide	21	0.552
Iron	0.05	
Fluoride	5	
P. alkalinity, in terms of calcium carbonate	Less than 0.1	
MO alkalinity, in terms of calcium carbonate	335	
Hardness, in terms of calcium carbonate	170	
Total dissolved solids	565	

Σ Cation = 10.13
Σ anion = 9.98
[illegible] : 0.7

pH 7.7

THE INDUSTRIAL LABORATORIES COMPANY
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TELEPHONE 455-3641

ANALYSIS REPORT

ATLANTIC RICHFIELD COMPANY
2 Park Central, Suite 555
1515 Arapahoe Street
Denver, Colorado 80202

Attn: John Matis

DATE RECEIVED: 8/9/74
DATE REPORTED: 8/16/74

LAB. NUMBER: 2012-1

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SAMPLE MARKED: GG #11 7/30/74 1,075 Feet

ANALYSIS:

	MILLIGRAMS PER LITER	MILLI-EQUIVALENTS	
Calcium (Ca)	21	1.048	
Magnesium (Mg)	24	1.975	
Sodium (Na)	185	8.048	
Carbonate	Less than 0.1	-----	
Bicarbonate (HCO_3)	435	7.134	
Chloride (Cl)	25	0.705	
Sulfate (SO_4)	120	2.538	2,500
Nitrate (NO_3)	5.3	-----	
Phosphate (PO_4)	Less than 0.01	-----	
Silicon dioxide (SiO_2)	24	0.631	
Iron (Fe)	0.11		
Fluoride (F)	6		
P. alkalinity, in terms of calcium carbonate	Less than 0.1		
MO alkalinity, in terms of calcium carbonate	355		
Hardness, in terms of calcium carbonate	150		
Total dissolved solids	640		

Σ Cations = 11.07
Σ Anions = 10.35
% Diff = 3.2

pH 7.8

MEMBERS OF:
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THE INDUSTRIAL LABORATORIES COMPANY
H. Paul [illegible]
CHEMIST

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ANALYSIS REPORT

ATLANTIC RICHFIELD COMPANY

DATE RECEIVED: 8/9/74
DATE REPORTED: 8/16/74

LAB. NUMBER: 2012-2

SAMPLES ARE DISCARDED IN 15 DAYS FROM DATE OF REPORT UNLESS WE ARE REQUESTED, IN WRITING, TO RETAIN THEM FOR A LONGER PERIOD. PERISHABLE SAMPLES ARE USUALLY DISCARDED IMMEDIATELY UNLESS CLIENT HAS REQUESTED SPECIAL HANDLING (FREEZING, ETC.) IN ADVANCE.

SAMPLE MARKED: GG #11 7/30/74 1,125 Feet

ANALYSIS:

	MILLIGRAMS PER LITER	MILLI-EQUIVALENTS
Calcium	23	1.148
Magnesium	23	1.893
Sodium	175	7.613
Carbonate	Less than 0.1	-----
Bicarbonate	440	7.216
Chloride	20	0.564
Sulfate	110	2.288
Nitrate	11	-----
Phosphate	Less than 0.1	-----
Silicon dioxide	20	0.526
Iron	0.25	
Fluoride	7	
P. alkalinity, in terms of calcium carbonate	Less than 0.1	
MO alkalinity, in terms of calcium carbonate	360	
Hardness, in terms of calcium carbonate	150	
Total dissolved solids	625	

Σ cations = 10.65
Σ anions = 10.07
% Diff = 2.8

pH 7.8

MEMBERS OF:

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THE INDUSTRIAL LABORATORIES COMPANY
H. Paul Ochs
CHEMIST

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ANALYSIS REPORT

TELEPHONE 455-3641

ATLANTIC RICHFIELD COMPANY

DATE RECEIVED: 8/9/74
DATE REPORTED: 8/16/74

LAB. NUMBER: 2012=4

SAMPLES ARE DISCARDED IN 15 DAYS FROM DATE OF REPORT UNLESS WE ARE REQUESTED, IN WRITING, TO RETAIN THEM FOR A LONGER PERIOD. PERISHABLE SAMPLES ARE USUALLY DISCARDED IMMEDIATELY UNLESS CLIENT HAS REQUESTED SPECIAL HANDLING (FREEZING, ETC.) IN ADVANCE.

SAMPLE MARKED: GG #11 7/31/74 1,185 Feet

ANALYSIS:

	MILLIGRAMS PER LITER	MILLI-EQUIVALENTS
Calcium	9.8	0.489
Magnesium	23	1.893
Sodium	235	10.223
Carbonate	Less than 0.1	----
Bicarbonate	570	9.348
Chloride	27	0.761
Sulfate	95	1.976
Nitrate	0.4	----
Phosphate	0.4	----
Silicon dioxide	21	0.552
Iron	Less than 0.05	
Fluoride	9	
P. alkalinity, in terms of calcium carbonate	Less than 0.1	
MO alkalinity, in terms of calcium carbonate	470	
Hardness, in terms of calcium carbonate	120	
Total dissolved solids	610	
pH	7.8	

Σ Cations 12.61
Σ anions = 12.09
% Diff 2.1

MEMBERS OF:

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THE INDUSTRIAL LABORATORIES COMPANY

CHEMIST

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ATLANTIC RICHFIELD COMPANY

DATE RECEIVED: 8/23/74
DATE REPORTED: 8/27/74

LAB. NUMBER: 2312

SAMPLES ARE DISCARDED IN 15 DAYS FROM DATE OF REPORT UNLESS WE ARE REQUESTED, IN WRITING, TO RETAIN THEM FOR A LONGER PERIOD. PERISHABLE SAMPLES ARE USUALLY DISCARDED IMMEDIATELY UNLESS CLIENT HAS REQUESTED SPECIAL HANDLING (FREEZING, ETC.) IN ADVANCE.

SAMPLE MARKED: SG #11 1,330 Feet

ANALYSIS:

	MILLIGRAMS PER LITER	MILLI-EQUIVALENTS	
Calcium	100	5.090	5.000
Magnesium	79	6.502	
Sodium	220	9.758	9.565
Carbonate	Less than 0.1	-----	
Bicarbonate	630	10.332	
Chloride	28	0.790	
Sulfate	455	9.464	
Nitrate	Less than 0.1	-----	
Phosphate	Less than 0.1	-----	
Silicon dioxide	28	0.764	
Iron	Less than 0.05	------	
Fluoride	4.0	-----	

Σ [illegible] = 21.07
Σ [illegible] = 20.58
[illegible] = 1.2

	MILLIGRAMS PER LITER
P. alkalinity, in terms of calcium carbonate	Less than 0.1
MO alkalinity, in terms of calcium carbonate	520
Hardness, in terms of calcium carbonate	580
C.O.D.	17
Ammonia-nitrogen	Less than 0.1
MB-AS	Less than 0.5
Phenols	Less than 0.001
Cyanide	Less than 0.01
Hydrogen sulfide	Less than 0.1
Nitrite	Less than 0.1
Lithium	Less than 5
Barium	Less than 1
Hexavalent chromium	Less than 0.01

	MILLIGRAMS PER LITER
Arsenic	0.03
Selenium	Less than 0.01
Boron	1.0
Manganese	Less than 0.05
Mercury	Less than 0.01
Hydroxide	Less than 0.1
Total dissolved solids	1,350

pH 7.9
Turbidity Less than 1 unit

MEMBERS OF:

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AMERICAN CHEMICAL SOCIETY
AMERICAN OIL CHEMISTS' SOCIETY
ASS'N OF OFFICIAL RACING CHEMISTS
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THE INDUSTRIAL LABORATORIES COMPANY

CHEMIST

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THE INDUSTRIAL LABORATORIES COMPANY

Analytical and Consulting Chemists

2600 WEST 29TH AVENUE
DENVER, COLORADO 80211

TELEPHONE 455-3641

ANALYSIS REPORT

ATLANTIC RICHFIELD COMPANY

DATE RECEIVED: 8/23/74
DATE REPORTED: 8/27/74

LAB. NUMBER: 2313

SAMPLES ARE DISCARDED IN 15 DAYS FROM DATE OF REPORT UNLESS WE ARE REQUESTED, IN WRITING, TO RETAIN THEM FOR A LONGER PERIOD. PERISHABLE SAMPLES ARE USUALLY DISCARDED IMMEDIATELY UNLESS CLIENT HAS REQUESTED SPECIAL HANDLING (FREEZING, ETC.) IN ADVANCE.

SAMPLE MARKED: SG #11 1,385 Feet

ANALYSIS:

	MILLIGRAMS PER LITER	MILLI-EQUIVALENTS
Calcium	26	1.297
Magnesium	18	1.481
Sodium	240	10.616 10.135
Carbonate	Less than 0.1	-----
Bicarbonate	590	9.676
Chloride	21	0.592
Sulfate	120	2.496
Nitrate	Less than 0.1	-----
Phosphate	Less than 0.1	-----
Silicon dioxide	16	0.421
Iron	Less than 0.05	-----
Fluoride	11	0.177
Ammonia-nitrogen	0.3	
P. alkalinity, in terms of calcium carbonate	Less than 0.1	
MO alkalinity, in terms of calcium carbonate	470	
Hardness, in terms of calcium carbonate	140	
C.O.D.	14	
MB-AS	Less than 0.05	
Phenols	Less than 0.001	
Cyanide	Less than 0.01	
Hydrogen sulfide	Less than 0.1	
Nitrite	Less than 0.1	
Lithium	Less than 5	
Barium	Less than 1	
Hexavalent chromium	Less than 0.01	

Σ Cations = 13.21
Σ Anions = 12.94
% Diff = 1.0

	MILLIGRAMS PER LITER
Arsenic	0.02
Selenium	Less than 0.01
Boron	1.6
Manganese	Less than 0.05
Mercury	Less than 0.01
Hydroxide	Less than 0.1
Total dissolved solids	720

pH 7.5
Turbidity 2 units

THE INDUSTRIAL LABORATORIES COMPANY
H. Paul Ycks
CHEMIST

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ANALYSIS REPORT

ATLANTIC RICHFIELD

DATE RECEIVED: 9/11/74
DATE REPORTED: 9/17/74

LAB. NUMBER: 2702

SAMPLES ARE DISCARDED IN 15 DAYS FROM DATE OF REPORT UNLESS WE ARE REQUESTED, IN WRITING, TO RETAIN THEM FOR A LONGER PERIOD. PERISHABLE SAMPLES ARE USUALLY DISCARDED IMMEDIATELY UNLESS CLIENT HAS REQUESTED SPECIAL HANDLING (FREEZING, ETC.) IN ADVANCE.

SAMPLE MARKED: SG #11 Depth 2,465 feet Tap GG

ANALYSIS:

	MILLIGRAMS PER LITER	MILLI-EQUIVALENTS
Calcium	12	0.599
Magnesium	9	0.741
Sodium	295	12.906
Carbonate	40	1.332
Bicarbonate	570	9.184 9.344
Chloride	62	1.748
Sulfate	75	1.560
Nitrate	Less than 0.1	-----
Phosphate	Less than 0.1	-----
Silicon dioxide	16	0.421
Iron	Less than 0.05	
Fluoride	16	0.842

Σ cations : 14.23
Σ anions : 14.33
% Diff. : 2.1

			MILLIGRAMS PER LITER
P. alkalinity, in terms of calcium carbonate	33	Boron	0.4
		Mercury	Less than 0.01
MO alkalinity, in terms of calcium carbonate	460	Hydroxide	Less than 0.1
		Cadmium	0.01
Hardness, in terms of calcium carbonate	67	Copper	Less than 0.10
C.O.D.	40	Lead	0.05
Phenols	Less than 0.001	Manganese	Less than 0.05
Cyanide	Less than 0.01	Silver	Less than 0.01
Nitrite	0.1	Zinc	Less than 0.5
Sulfide	1.7	Total dissolved solids	1,320
		Calc.	804
Hexavalent chromium	Less than 0.01		
Arsenic	L 0.01	pH	8.0
Selenium	Less than 0.01	Turbidity	Less than 1 unit
Lithium	Less than 0.5		
Barium	Less than 1.0		

THE INDUSTRIAL LABORATORIES COMPANY

H. Paul Yeck

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THE INDUSTRIAL LABORATORIES COMPANY
Analytical and Consulting Chemists
2600 WEST 29TH AVENUE
DENVER, COLORADO 80211
TELEPHONE 455-3641

ANALYSIS REPORT

ATLANTIC RICHFIELD COMPANY
2 Park Central, Suite 555
1515 Arapahoe Street
Denver, Colorado 80202
Attn: John Matis

DATE RECEIVED: 9/11/74
DATE REPORTED: 9/17/74

LAB. NUMBER: 2701

SAMPLES ARE DISCARDED IN 15 DAYS FROM DATE OF REPORT UNLESS WE ARE REQUESTED, IN WRITING, TO RETAIN THEM FOR A LONGER PERIOD. PERISHABLE SAMPLES ARE USUALLY DISCARDED IMMEDIATELY UNLESS CLIENT HAS REQUESTED SPECIAL HANDLING (FREEZING, ETC.) IN ADVANCE.

SAMPLE MARKED: SG #11 TD 2825 feet

ANALYSIS:

	MILLIGRAMS PER LITER	MILLI-EQUIVALENTS
Calcium	23	1.148
Magnesium	14	1.152
Sodium	355	15.458
Carbonate	43	1.431
Bicarbonate	520	8.528
Chloride	115	3.243
Sulfate	195	4.056
Nitrate	Less than 0.1	-----
Phosphate	Less than 0.1	-----
Silicon dioxide	19	0.500
Ammonia-nitrogen	0.2	
Iron	Less than 0.05	
Fluoride	12	0.632
P. alkalinity, in terms of calcium carbonate	35	
MO alkalinity, in terms of calcium carbonate	425	
Hardness, in terms of calcium carbonate	115	
C.O.D.	40	
Phenols	Less than 0.01	
Cyanide	Less than 0.01	
Nitrite	Less than 0.1	
Sulfide	0.8	
Hexavalent chromium	Less than 0.01	
Arsenic	0.02	
Selenium	Less than 0.01	
Lithium	Less than 0.5	
Barium	Less than 1.0	

Σ cations = 17.76
Σ anions = 17.39
% diff. = 0.4

	MILLIGRAMS PER LITER
Boron	Less than 0.1
Mercury	Less than 0.01
Hydroxide	Less than 0.1
Cadmium	Less than 0.01
Copper	Less than 0.1
Lead	0.09
Manganese	Less than 0.05
Silver	Less than 0.01
Zinc	Less than 0.5
Total dissolved solids	1,530
Calc.	1030

pH 8.0
Turbidity Less than 1 unit

THE INDUSTRIAL LABORATORIES COMPANY
H. Paul Ucker
CHEMIST

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IN PART FOR ADVERTISING PURPOSES WITHOUT OBTAINING PRIOR WRITTEN AUTHORIZATION

Elemental Analysis – Mass Spectrometry

C & L LABORATORIES

General Analytical Services

14335 West 44th Ave
Golden, Colo. 80401
(303) 278-9521

To: Mr. Frank Haas
The Oil Shale Corp.
18200 West Hiway 72
Golden, CO 80401

Date: 8-16-74

Analyst: S. Sweeney

C & L No.: 97-089-002-02

Customer No.:
Sample No.: SG #11 808.1'

CONCENTRATION IN µg/ml

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium		Terbium		Ruthenium		Vanadium	0.01
Thorium		Gadolinium		Molybdenum	0.2	Titanium	0.2
Bismuth		Europium		Niobium	0.005	Scandium	0.008
Lead		Samarium		Zirconium		Calcium	MC
Thallium		Neodymium		Yttrium		Potassium	1.5
Mercury *	0.88	Praseodymium		Strontium	7	Chlorine	≈20
Gold		Cerium		Rubidium	0.008	Sulfur	MC
Platinum		Lanthanum		Bromine	0.03	Phosphorus	1
Iridium		Barium	0.04	Selenium		Silicon	4
Osmium		Cesium	0.007	Arsenic	0.03	Aluminum	0.6
Rhenium		Iodine	0.01	Germanium		Magnesium	MC
Tungsten		Tellurium		Gallium	0.01	Sodium	MC
Tantalum	**	Antimony		Zinc	0.06	Fluorine	≈19
Hafnium		Tin		Copper	0.3	Oxygen	NR
Lutetium		Indium	STD	Nickel	0.07	Nitrogen	NR
Ytterbium		Cadmium		Cobalt	0.03	Carbon	NR
Thulium		Silver		Iron	0.7	Boron	0.02
Erbium		Palladium		Manganese	0.4	Beryllium	
Holmium		Rhodium		Chromium	0.09	Lithium	0.4
Dysprosium						Hydrogen	NR

NR - Not Reported
All elements not reported <0.001 µg/ml
**Source Contamination

*Flameless Atomic Absorption

C & L LABORATORIES Elemental Analysis — Mass Spectrometry

General Analytical Services

14335 West 44th Ave
Golden, Colo. 80401
(303) 278-9521

To: Mr. Frank Haas
The Oil Shale Corp.
18200 West Hiway 72
Golden, CO 80401

Date: 8-15-74

Analyst: S. Sweeney

Customer No.:

C & L No.: 97-087-002-02

Sample No.: SG #11 868.0'

μg/ml
CONCENTRATION IN

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	
Uranium		Terbium		Ruthenium		Vanadium	0.003
Thorium		Gadolinium		Molybdenum		Titanium	0.1
Bismuth		Europium		Niobium		Scandium	0.003
Lead		Samarium		Zirconium		Calcium	≈28
Thallium		Neodymium		Yttrium		Potassium	1
Mercury ***	0.00095	Praseodymium		Strontium	3	Chlorine	15
Gold		Cerium		Rubidium	0.01	Sulfur	≈28
Platinum		Lanthanum		Bromine	0.03	Phosphorus	1
Iridium		Barium	0.04	Selenium		Silicon	3
Osmium		Cesium	0.007	Arsenic	0.02	Aluminum	2
Rhenium		Iodine	0.03	Germanium		Magnesium	0.01
Tungsten		Tellurium		Gallium		Sodium	MC
Tantalum	**	Antimony		Zinc	0.1	Fluorine	≈4
Hafnium		Tin		Copper	0.06	Oxygen	NR
Lutetium		Indium	STD	Nickel	0.01	Nitrogen	NR
Ytterbium		Cadmium		Cobalt	0.02	Carbon	NR
Thulium		Silver	<	Iron	* 0.5	Boron	0.02
Erbium		Palladium		Manganese	0.08	Beryllium	0.0005
Holmium		Rhodium		Chromium	0.03	Lithium	0.06
Dysprosium						Hydrogen	NR

NR - Not Reported <0.001 μg/ml
All elements not reported
**Source Contamination ***Flameless Atomic Absorption
*Heterogeneous

WATER QUALITY ANALYSES

SG - 18

TRACT C-b

TABLE 1

MAJOR CONSTITUENT ANALYSES
CORE HOLE SG-18

	960-feet	1380-feet		1425.6-feet	ENVIRON SMPL 1330' J.G.G. 11-1-74
Component, mg/l	Industrial	Industrial	TOSCO	Industrial	TOSCO
Na	169	190	167	176	135
K	NA	NA	0.4	NA	0.4
Ca	51	7.4	4	18	24
Mg	6.1	5.7	4	11	30
SO_4	74	4.0	1	42	84
CO_3	17	<0.1	3	<0.1	0
HCO_3	460	496	462	460	471
Cl	6.8	0.7	1	1.4	3
F	9.1	10.1	13	9.9	5.4
$\sum$Cations, meq/l	10.40	9.10	7.80	9.46	9.55
$\sum$Anions, meq/l	10.13	8.66	8.40	8.94	9.84
% Difference	1.3	2.5	3.7	2.8	1.5
Silica, mg/l	21	13	13	17	23
pH	8.3	8.0	8.3	8.0	8.2
Calculated TDS, mg/l	579	474	433	501	536

NA - Not Analyzed

THE INDUSTRIAL LABORATORIES COMPANY

Analytical and Consulting Chemists

2600 WEST 29TH AVENUE
DENVER, COLORADO 80211
ANALYSIS REPORT

TELEPHONE 455-3541

ATLANTIC RICHFIELD COMPANY

DATE RECEIVED: 10/17/74
DATE REPORTED: 11/4/74

LAB. NUMBER: 3737

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SAMPLE MARKED: Sorghum Gulch #18 950 Feet Top of Parachute Creek

ANALYSIS:

	MILLIGRAMS PER LITER	MILLI-EQUIVALENTS
Calcium	51	2.545
Magnesium	6.1	0.502
Sodium	169	7.352
Carbonate	17	0.566
Bicarbonate	460	7.544
Chloride	6.8	-----
Sulfate	74	1.539
Nitrate	Less than 0.1	-----
Phosphate	Less than 0.1	-----
Silicon dioxide	21	0.699
Iron	0.32	-----
Fluoride	9.1	0.482
P. alkalinity, in terms of calcium carbonate	---	
MO alkalinity, in terms of calcium carbonate	---	
Hardness, in terms of calcium carbonate	152	
Total dissolved solids	557	
Ammonia	0.2	
Lithium	Less than 0.5	
Barium	Less than 1.0	
Hexavalent chromium	Less than 0.01	
Arsenic	Less than 0.01	
Selenium	Less than 0.01	
Boron	0.4	
Hydroxide	Less than 0.1	

Σ cations = 10.40
Σ anions = 10.13
% Diff = 1.3

	MILLIGRAMS PER LITER
Aluminum	3.2
Copper	Less than 0.1
Cadmium	Less than 0.01
Lead	Less than 0.05
Manganese	Less than 0.05
Silver	Less than 0.01
Zinc	Less than 0.5
Mercury	Less than 0.01

pH 8.3
Specific conductance 710 micromhos per cc

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ANALYSIS REPORT

ATLANTIC RICHFIELD

DATE RECEIVED: 10/17/74
DATE REPORTED: 10/[illegible]/74

LAB. NUMBER: 0752

SAMPLES ARE DISCARDED IN 15 DAYS FROM DATE OF REPORT UNLESS WE ARE REQUESTED, IN WRITING, TO RETAIN THEM FOR A LONGER PERIOD. PERISHABLE SAMPLES ARE USUALLY DISCARDED IMMEDIATELY UNLESS CLIENT HAS REQUESTED SPECIAL HANDLING (FREEZING, ETC.) IN ADVANCE.

SAMPLE MARKED: Sorghum Gulch #13 1,380 Feet 10/3/74

ANALYSIS:

	MILLIGRAMS PER LITER		MILLI-EQUIVALENTS
Calcium	7.4		0.369
Magnesium	5.7		0.469
Sodium	190	Σ cations = 9.10	8.265
Carbonate	Less than 0.1	Σ anions = 8.66	-----
Bicarbonate	496	% Diff = 2.5	8.134
Chloride	0.7		-----
Sulfate	4.0		-----
Nitrate	Less than 0.1		-----
Phosphate	Less than 0.1		-----
Silicon dioxide	13		0.433
Iron	0.06		-----
Fluoride	10.1		0.530
Hardness, in terms of calcium carbonate	42		
Ammonia	0.3		
Lithium	Less than 0.5		
Barium	Less than 1.0		
Hexavalent chromium	Less than 0.01		
Arsenic	Less than 0.01		
Selenium	Less than 0.01		
Boron	0.6		
Hydroxide	Less than 0.1		
Aluminum	Less than 0.05		
Copper	Less than 0.1		
Cadmium	Less than 0.01		
Lead	Less than 0.05		
Manganese	Less than 0.05		

	MILLIGRAMS PER LITER
Silver	Less than 0.5
Mercury	Less than 0.01
Total dissolved solids	473

pH 8.0
Specific conductance 670 micromhos per cc

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cc: John Matis/Frank Haas

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Analytical and Consulting Chemists

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DENVER, COLORADO 80211
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ANALYSIS REPORT

ATLANTIC RICHFIELD COMPANY
1500 Security Life Building
Denver, Colorado 80202

Attn: Don Tait

DATE RECEIVED: 10/17/74
DATE REPORTED: 10/[illegible]/74

LAB. NUMBER: 3761

SAMPLES ARE DISCARDED IN 15 DAYS FROM DATE OF REPORT UNLESS WE ARE REQUESTED, IN WRITING, TO RETAIN THEM FOR A LONGER PERIOD. PERISHABLE SAMPLES ARE USUALLY DISCARDED IMMEDIATELY UNLESS CLIENT HAS REQUESTED SPECIAL HANDLING (FREEZING, ETC.) IN ADVANCE.

SAMPLE MARKED: Sorghum Gulch #18 1425.6 Feet 10/5/74

ANALYSIS:

	MILLIGRAMS PER LITER		MILLI-EQUIVALENTS
Calcium	18		0.898
Magnesium	11		0.905
Sodium	176	Σ cations = 9.46	7.656
Carbonate	Less than 0.1	Σ anions = 8.94	------
Bicarbonate	460	% Diff = 2.8	7.544
Chloride	1.4		------
Sulfate	42		0.874
Nitrate	0.1		------
Phosphate	Less than 0.1		------
Silicon dioxide	17		0.566
Iron	0.03		------
Fluoride	9.9		0.523
Hardness, in terms of calcium carbonate	90		
Ammonia	0.3		
Lithium	Less than 0.5		
Barium	Less than 1.0		
Hexavalent chromium	Less than 0.01		
Arsenic	Less than 0.01		
Selenium	Less than 0.01		
Boron	0.4		
Hydroxide	Less than 0.1		
Aluminum	0.8		
Copper	Less than 0.1		
Cadmium	Less than 0.01		
Lead	Less than 0.05		
Silver	Less than 0.01		

	MILLIGRAMS PER LITER
Manganese	Less than 0.05
Zinc	Less than 0.5
Mercury	Less than 0.01
Total dissolved solids	485

pH 8.0
Specific conductance
750 micromhos per cc.

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cc: John Matis/Frank Haas

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H. Paul
CHEMIST

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CABLE ADDRESS COMTECO

COMMERCIAL TESTING & ENGINEERING CO.
GENERAL OFFICES: 228 NORTH LA SALLE STREET, CHICAGO, ILLINOIS 60601 • AREA CODE 312 726-8434

Reply to
Instrumental Analysis Division
14335 West 44th Avenue
Golden, Colorado 80401

Phone: 303-278-9521

20 November 74

Mr. Frank Haas
The Oil Shale Corporation
18200 West Hiway 72
Golden, CO 80401

Re: IAD #97-153-002-04

ANALYTICAL REPORT

	TOC* mg/liter	Nitrates** mg/liter N
Aquifer Test #1 after pumping 15 hrs.	<1	0.34
Well 1-C String #2	8	0.10
✓ ARCO SG #18-A T.D. 1330' JGC 11-1-74	<1	0.22
ARCO SG-9 2750'	<1	0.056 ✓

*Test performed on samples marked "Regular" and run by an outside laboratory.

**Test performed on samples marked "Hg for N"

Charles R. Wilson
Charles R. Wilson
Analyst

M L Jacobs
Approved by:
M. L. Jacobs Ph.D.
Divisional Manager

CRW/hb

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NOV 25 1974
TOSCO-GOLDEN

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COMMERCIAL TESTING & ENGINEERING CO.
GENERAL OFFICES: 228 NORTH LA SALLE STREET, CHICAGO, ILLINOIS 60601 · AREA CODE 312 726-8434

Reply to
Instrumental Analysis Division
14335 West 44th Avenue
Golden, Colorado 80401

Phone: 303-278-9521

12 November 74

Mr. Frank Haas
The Oil Shale Corporation
18200 West Hiway 72
Golden, Colorado 80401

Re: IAD #97-140-002-33

ANALYTICAL REPORT

Samples	TOC* mg/liter	Nitrate** mg/liter N	Free Ammonia** mg/liter N
ARCO et.al. SG #18 c-b @ 1380'	3	0.26	0.017
ARCO et.al. SG #18 960' Top of para Cr. 800 mΩ	3	<0.04	0.013
ARCO et.al. Wtr. samples SG #19 Top of para Cr. @ 466'	4	0.28	0.012
ARCO SG #19 @ 860'	4	0.21	0.018
ARCO SG #19 TD @ 981'	3	0.34	0.040
SG #9 Top of Mining Zone 1285'	3	3.35	0.025
SG #18 Base of Mining Zone TD 1425.6 (800mΩ)	3	3.40	0.029
SG #9 Btm of Mining Zone @ 1360'	4	0.27	0.042
ARCO SG #9 Core Point @ 1200'	4	0.76	0.022
ARCO et.al. SG #9 @ 993' Top of parachute creek 800 mΩ	4	0.32	0.013

* Test performed on samples marked 'Regular'
** Test performed on samples marked 'Hg for N'

Charles R. Wilson
Charles R. Wilson, Analyst

Approved by:
M. L. Jacobs, Ph.D.
Divisional Manger

CRW/dh

COMMERCIAL TESTING & ENGINEERING CO.
GENERAL OFFICES: 228 NORTH LA SALLE STREET, CHICAGO, ILLINOIS 60601 · AREA CODE 312 726-8434
Reply to INSTRUMENTAL ANALYSIS DIVISION, 14335 WEST AVENUE, GOLDEN, COLORADO, 80401, PHONE: 303-278-9521

To: Mr. Frank Haas
The Oil Shale Corporation
18200 West Hiway 72
Golden, Colorado 80401

Date: 8 November

Analyst: S. Sweeney

P. O. No.:

Sample No.: ARCO et.al. SG #18 960' Top of para cr. 800 mΩ

IAD No.: 97-140-002-33

CONCENTRATION IN µg/ml

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium		Terbium		Ruthenium		Vanadium	0.004
Thorium		Gadolinium		Molybdenum	0.04	Titanium	0.2
Bismuth		Europium		Niobium		Scandium	
Lead	0.07	Samarium		Zirconium	0.01	Calcium	*
Thallium		Neodymium		Yttrium		Potassium	*
Mercury	**0.0001	Praseodymium		Strontium	2	Chlorine	*
Gold		Cerium		Rubidium	0.01	Sulfur	*
Platinum		Lanthanum		Bromine	0.01	Phosphorus	0.2
Iridium		Barium	0.01	Selenium		Silicon	*
Osmium		Cesium		Arsenic	0.008	Aluminum	2
Rhenium		Iodine		Germanium		Magnesium	*
Tungsten		Tellurium		Gallium		Sodium	*
Tantalum		Antimony		Zinc	0.2	Fluorine	*
Hafnium		Tin		Copper	0.008	Oxygen	NR
Lutetium		Indium	STD	Nickel	0.01	Nitrogen	NR
Ytterbium		Cadmium		Cobalt		Carbon	NR
Thulium		Silver		Iron	2	Boron	0.03
Erbium		Palladium		Manganese	0.04	Beryllium	
Holmium		Rhodium		Chromium	0.01	Lithium	0.2
Dysprosium						Hydrogen	NR

NR -- Not Reported
All elements not reported <0.02 µg/ml
* Not reported upon request
** Flameless Atomic Absorption

Approved:

COMMERCIAL TESTING & ENGINEERING CO.
GENERAL OFFICES: 228 NORTH LA SALLE STREET, CHICAGO, ILLINOIS 60601 • AREA CODE 312 726-8434
Reply to INSTRUMENTAL ANALYSIS DIVISION, 14335 WEST AVENUE, GOLDEN, COLORADO, 80401, PHONE: 303-278-9521

To: Mr. Frank Haas
The Oil Shale Corporation
18200 West Hiway 72
Golden, Colorado 80401

Date: 8 November 74

Analyst: S. Sweeney

P. O. No.:

Sample No.: ARCO et.al. SG #18 c-b @ 1380'

IAD No.: 97-140-002-33

CONCENTRATION IN μg/ml

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium		Terbium		Ruthenium		Vanadium	0.004
Thorium		Gadolinium		Molybdenum	0.02	Titanium	0.1
Bismuth		Europium		Niobium		Scandium	
Lead	0.04	Samarium		Zirconium		Calcium	*
Thallium		Neodymium		Yttrium	0.003	Potassium	*
Mercury	**0.001	Praseodymium		Strontium	0.3	Chlorine	*
Gold		Cerium	0.005	Rubidium	0.005	Sulfur	*
Platinum		Lanthanum		Bromine	0.005	Phosphorus	0.2
Iridium		Barium	0.05	Selenium		Silicon	*
Osmium		Cesium		Arsenic	0.01	Aluminum	0.9
Rhenium		Iodine		Germanium		Magnesium	*
Tungsten		Tellurium		Gallium		Sodium	*
Tantalum		Antimony		Zinc	0.009	Fluorine	*
Hafnium		Tin		Copper	0.008	Oxygen	NR
Lutetium		Indium	STD	Nickel	0.006	Nitrogen	NR
Ytterbium		Cadmium		Cobalt		Carbon	NR
Thulium		Silver		Iron	0.5	Boron	0.01
Erbium		Palladium		Manganese	0.01	Beryllium	<0.001
Holmium		Rhodium		Chromium	0.01	Lithium	0.2
Dysprosium						Hydrogen	NR

NR - Not Reported
All elements not reported <0.007 μg/ml
* Not reported upon request
** Flameless Atomic Absorption

Approved:

COMMERCIAL TESTING & ENGINEERING CO.
Reply to
GENERAL OFFICES· 228 NORTH LA SALLE STREET, CHICAGO, ILLINOIS 60601 · AREA CODE 312 726-8434
INSTRUMENTAL ANALYSIS DIVISION, 14335 WEST AVENUE, GOLDEN, COLORADO, 80401, PHONE: 303-278-9521

To: Mr. Frank Haas
The Oil Shale Corporation
18200 West Hiway 72
Golden, Colorado 80401

Date: 8 November 74

Analyst: S. Sweeney

P. O. No.:

Sample No.: SG #18 Base of Mining Zone TD
1425.6 (800mΩ)

IAD No.: 97-140-002-33

CONCENTRATION IN μg/ml

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium		Terbium		Ruthenium		Vanadium	0.003
Thorium		Gadolinium		Molybdenum	0.02	Titanium	0.1
Bismuth		Europium		Niobium		Scandium	
Lead	0.09	Samarium		Zirconium	0.006	Calcium	*
Thallium		Neodymium		Yttrium	0.003	Potassium	*
Mercury	**0.0001	Praseodymium		Strontium	0.8	Chlorine	*
Gold		Cerium		Rubidium	0.004	Sulfur	*
Platinum		Lanthanum		Bromine	0.01	Phosphorus	0.3
Iridium		Barium	0.03	Selenium		Silicon	*
Osmium		Cesium		Arsenic	0.02	Aluminum	0.4
Rhenium		Iodine		Germanium		Magnesium	*
Tungsten		Tellurium		Gallium		Sodium	*
Tantalum		Antimony		Zinc	0.03	Fluorine	*
Hafnium		Tin		Copper	0.01	Oxygen	NR
Lutetium		Indium	STD	Nickel	0.008	Nitrogen	NR
Ytterbium		Cadmium		Cobalt	0.004	Carbon	NR
Thulium		Silver		Iron	2	Boron	0.02
Erbium		Palladium		Manganese	0.07	Beryllium	
Holmium		Rhodium		Chromium	0.01	Lithium	1
Dysprosium						Hydrogen	NR

NR -- Not Reported
All elements not reported <0. 008 μg/ml
* Not reported upon request
** Flameless Atomic Absorption

Approved:

HAZEN RESEARCH, INC.
4601 Indiana Street
Golden, Colorado 80401

Mr. Frank Haas
The Oil Shale Corporation

Date: November 27, 1974
HRI Project No. 535
HRI Series No. 7515
Samples received: Oct. 22, 1974

Page 2

REPORT OF ANALYSIS

Analysis No.	Sample Description	pCi/l			pCi/l			pCi/l		
		α Total	±	α Precision*	β Total	±	β Precision*	Ra^{226}	±	Precision*
7515-21	9 Bottom-1360'	1.5	±	2.7	0	±	15			
-22	Top of parachute 9 Creek-993'	3.4	±	2.1	0	±	13			
-23	Top of mining zone 9-1285'	5.7	±	2.7	0	±	14	0.9	±	0.6
-24	A-10 67'	2.3	±	2.5	0	±	14			
-25	A-11 65'	2.2	±	2.6	0	±	14			
-26	A-11 66'	5.0	±	3.2	0	±	15	0	±	0.3
-27	A-12 78'	1.6	±	2.4	0	±	14			
-28 ✓	18-Base 1425.6'	4.0	±	2.2	0	±	13			
-29 ✓	18-1380'	1.8	±	1.9	0	±	13			
-30 ✓	Top of para. 18-960'	0.6	±	1.7	0	±	13			
-31	Top of para. 19-466'	2.8	±	2.1	0	±	13			
-32	19-860'	0.7	±	2.6	0	±	15			
-33	19-TD-981'	0	±	3.4	0	±	33			

*Variability of the radioactive disintegration process (counting error) at the 95% confidence level, 1.96σ

By:
John C. Jarvis
Manager, Analytical Laboratory

ljb

HAZEN RESEARCH, INC.
4601 Indiana Street
Golden, Colorado 80401

Mr. F. C. Haas
The Oil Shale Corporation
18200 West Highway 72
Golden, Colorado 80401

Date: December 3, 1974
HRI Project No. 535
HRI Series No. 7559
Samples received: November 1, 1974

REPORT OF ANALYSIS

Analysis No.	Sample Designation	α Total	pCi/l ±	α Precision*	β Total	pCi/l ±	β Precision*	Ra^{226}	pCi/l ±	Precision*
7559-1	Aquifer Test #1 Pumped 15 hrs.	4.2	±	2.3	0	±	11	0.3	±	0.5
-2	Well #1-C String #2	0.6	±	3.4	9	±	12			
-3	SG-9 2750'	5.5	±	2.6	0	±	11	0	±	0.4
-4✓	SG-18-A TD 1380 JGG 11-1-74	8.0	±	3.3	0	±	11	0.1	±	0.4

By: John C. Jarvis
John C. Jarvis
Manager, Analytical Laboratory

ljb

*Variability of the radioactive disintegration process (counting error) at the 95% confidence level, 1.96σ

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DEC 4 1974
TOSCO-GOLDEN

COMMERCIAL TESTING & ENGINEERING CO.
GENERAL OFFICES: 228 NORTH LA SALLE STREET, CHICAGO, ILLINOIS 60601 • AREA CODE 312 726-8434
Reply to INSTRUMENTAL ANALYSIS DIVISION, 14335 WEST AVENUE, GOLDEN, COLORADO, 80401, PHONE: 303-278-9521

To: Mr. Frank Haas
The Oil Shale Corporation
18200 West Hiway 72
Golden, Colo. 80401

Date: 20 November 74

Analyst: S. Sweeney

P. O. No.:

Sample No.: ARCO Sg #18-A T.D. 1380' 30
JGG 11-1-74

IAD No.: 97-153-002-04

CONCENTRATION IN ~~PPM WEIGHT~~ µg/ml

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium		Terbium		Ruthenium		Vanadium	0.001
Thorium		Gadolinium		Molybdenum	0.03	Titanium	0.04
Bismuth		Europium		Niobium		Scandium	0.003
Lead	≤0.02	Samarium		Zirconium		Calcium	*
Thallium		Neodymium		Yttrium		Potassium	*
Mercury	** 0.0024	Praseodymium		Strontium	0.3	Chlorine	*
Gold		Cerium		Rubidium	0.004	Sulfur	*
Platinum		Lanthanum		Bromine	0.01	Phosphorus	0.3
Iridium		Barium	0.03	Selenium		Silicon	*
Osmium		Cesium		Arsenic	0.02	Aluminum	0.5
Rhenium		Iodine		Germanium		Magnesium	*
Tungsten		Tellurium		Gallium		Sodium	*
Tantalum		Antimony		Zinc	0.03	Fluorine	*
Hafnium		Tin		Copper	0.02	Oxygen	NR
Lutetium		Indium	STD	Nickel	0.005	Nitrogen	NR
Ytterbium		Cadmium		Cobalt	0.001	Carbon	NR
Thulium		Silver		Iron	0.2	Boron	0.02
Erbium		Palladium		Manganese	0.02	Beryllium	
Holmium		Rhodium		Chromium	0.001	Lithium	0.3
Dysprosium						Hydrogen	NR

NR -- Not Reported
All elements not reported <0.007 µg/ml
*Not reported upon request
**Flameless Atomic Absorption

Approved:

WATER QUALITY ANALYSES

SG - 19

TRACT C-b

TABLE 1

MAJOR CONSTITUENT ANALYSES, CORE HOLE SG-19

	466-feet		860-feet		981-feet		[illegible] D.B. Tait J.G.G. 11-1-74
Component, mg/l	Industrial	TOSCO	Industrial	TOSCO	Industrial	TOSCO	TOSCO
Na	220	198	527	489	762	722	762
K	NA	0.4	NA	0.6	NA	0.9	1.1
Ca	8.6	4	7.8	3	11	4	4
Mg	1.3	3	0.9	2	<0.1	3	3
SO_4	9.4	15	<4	0	<4	0	0
CO_3	17	5	81	27	70	19	50
HCO_3	480	516	1160	1151	1750	1820	1173
Cl	9.5	3	6.8	6	<0.1	10	12
F	9.3	4	10	16	10	22	23
Σ Cations, meq/l	10.11	9.07	23.39	21.59	33.70	31.86	33.61
Σ Anions, meq/l	9.39	8.92	22.44	20.78	31.72	31.91	32.28
% Difference	3.7	0.8	2.1	1.9	3.0	0.1	2.0
Silica, mg/l	10	14	11	11	8.4	10	9
pH	8.3	8.3	8.7	8.5	8.6	8.4	8.7
Calculated TDS, mg/l	520	499	1213	1119	1724	1681	1733

NA - Not analyzed

THE INDUSTRIAL LABORATORIES COMPANY

Analytical and Consulting Chemists

2600 WEST 29TH AVENUE
DENVER, COLORADO 80211
TELEPHONE 455-364[illegible]

ANALYSIS REPORT

ATLANTIC RICHFIELD COMPANY

DATE RECEIVED: 10/[illegible]/77
DATE REPORTED: 11/[illegible]/77

LAB. NUMBER: 37[illegible]

SAMPLES ARE DISCARDED IN 15 DAYS FROM DATE OF REPORT UNLESS WE ARE REQUESTED, IN WRITING, TO RETAIN THEM FOR A LONGER PERIOD. PERISHABLE SAMPLES ARE USUALLY DISCARDED IMMEDIATELY UNLESS CLIENT HAS REQUESTED SPECIAL HANDLING (FREEZING, ETC.) IN ADVANCE.

SAMPLE MARKED: Sorghum Gulch #19 456 Feet Top of Parachute Creek

ANALYSIS:

	MILLIGRAMS PER LITER	MILLI-EQUIVALENTS
Calcium	8.6	0.429
Magnesium	1.3	0.107
Sodium	220	9.570
Carbonate	17	0.566
Bicarbonate	480	7.872
Chloride	9.5	0.268
Sulfate	9.4	0.196
Nitrate	2.3	----
Phosphate	Less than 0.1	----
Silicon dioxide	10	0.333
Iron	1.06	---
Fluoride	9.3	0.489
P. alkalinity, in terms of calcium carbonate	---	
MO alkalinity, in terms of calcium carbonate	---	
Hardness, in terms of calcium carbonate	27	
Total dissolved solids	520	
Ammonia	0.3	
Lithium	Less than 0.5	
Barium	Less than 1.0	
Hexavalent chromium	Less than 0.01	
Arsenic	Less than 0.01	
Selenium	Less than 0.01	
Boron	0.4	
Hydroxide	Less than 0.1	

Σ cations = 10.11
Σ anions = 9.39
% Diff = 3.7

	MILLIGRAMS PER LITER
Aluminum	5.4
Copper	Less than 0.1
Cadmium	Less than 0.01
Lead	Less than 0.05
Manganese	Less than 0.05
Silver	Less than 0.01
Zinc	Less than 0.5
Mercury	Less than 0.01

pH 8.3
Specific conductance 730 micromhos per cc

MEMBERS OF:
AMERICAN ASS'N OF CEREAL CHEMISTS
AMERICAN CHEMICAL SOCIETY
AMERICAN OIL CHEMISTS' SOCIETY
ASS'N OF OFFICIAL RACING CHEMISTS
BAKERY ENGINEERS OF AMERICA
INSTITUTE OF FOOD TECHNOLOGY
SIGMA XI

THE INDUSTRIAL LABORATORIES COMPANY
J. Paul [illegible]
CHEMIST

THIS REPORT IS NOT TO BE REPRODUCED, IN WHOLE OR IN PART, FOR ADVERTISING PURPOSES WITHOUT OBTAINING PRIOR WRITTEN AUTHORIZATION

THE INDUSTRIAL LABORATORIES COMPANY

Analytical and Consulting Chemists

2600 WEST 29TH AVENUE
DENVER, COLORADO 80211

TELEPHONE 455-3641

ANALYSIS REPORT

ATLANTIC RICHFIELD COMPANY

DATE RECEIVED: 10/17/74
DATE REPORTED: 11/5/74

LAB. NUMBER: 3786

SAMPLES ARE DISCARDED IN 15 DAYS FROM DATE OF REPORT UNLESS WE ARE REQUESTED IN WRITING TO RETAIN THEM FOR A LONGER PERIOD. PERISHABLE SAMPLES ARE USUALLY DISCARDED IMMEDIATELY UNLESS CLIENT HAS REQUESTED SPECIAL HANDLING (FREEZING, ETC.) IN ADVANCE.

SAMPLE MARKED: Sorghum Gulch #10 860 Feet

ANALYSIS:

	MILLIGRAMS PER LITER	MILLI-EQUIVALENTS
Calcium	7.8	0.389
Magnesium	0.9	0.074
Sodium	527	22.925
Carbonate	81	2.697
Bicarbonate	1,160	19.024
Chloride	6.8	---
Sulfate	Less than 4.0	---
Nitrate	Less than 0.8	---
Phosphate	Less than 0.1	---
Silicon dioxide	11	0.365
Iron	1.0	---
Fluoride	10	0.523
P. alkalinity, in terms of calcium carbonate	---	
MO alkalinity, in terms of calcium carbonate	---	
Hardness, in terms of calcium carbonate	23	
Total dissolved solids	1,210	
Ammonia	0.4	
Lithium	Less than 0.5	
Barium	Less than 1.0	
Hexavalent chromium	Less than 0.01	
Arsenic	Less than 0.01	
Selenium	Less than 0.01	
Boron	0.4	
Hydroxide	Less than 0.1	

Σ cations = 23.39
Σ anions = 22.44
% Diff = 2.1

	MILLIGRAMS PER LITER
Aluminum	3.2
Copper	Less than 0.1
Cadmium	Less than 0.01
Lead	Less than 0.05
Manganese	Less than 0.05
Silver	Less than 0.01
Zinc	Less than 0.5
Mercury	Less than 0.01

pH 8.7
Specific conductance 1,640 micromhos per cc

THE INDUSTRIAL LABORATORIES COMPANY
H. Paul Ocks
CHEMIST

MBERS OF:

AMERICAN ASS'N OF CEREAL CHEMISTS
AMERICAN CHEMICAL SOCIETY
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THE INDUSTRIAL LABORATORIES COMPANY

Analytical and Consulting Chemists

2600 WEST 29TH AVENUE
DENVER, COLORADO 80211
TELEPHONE 455-3641

ANALYSIS REPORT

ATLANTIC RICHFIELD COMPANY

DATE RECEIVED: 10/17/74
DATE REPORTED: 11/4/74

LAB. NUMBER: 3789

SAMPLES ARE DISCARDED IN 15 DAYS FROM DATE OF REPORT UNLESS WE ARE REQUESTED, IN WRITING, TO RETAIN THEM FOR A LONGER PERIOD. PERISHABLE SAMPLES ARE USUALLY DISCARDED IMMEDIATELY UNLESS CLIENT HAS REQUESTED SPECIAL HANDLING (FREEZING, ETC.) IN ADVANCE.

SAMPLE MARKED: Sorghum Gulch #19 TD 981 Feet

ANALYSIS:

	MILLIGRAMS PER LITER		MILLI-EQUIVALENTS
Calcium	11		0.549
Magnesium	Less than 0.1		----
Sodium	762	Σ cations = 33.70	33.147
Carbonate	70	Σ anions = 31.72	2.331
Bicarbonate	1,760	% Diff = 3.0	28.854
Chloride	Less than 0.1		----
Sulfate	Less than 4.0		----
Nitrate	Less than 0.1		----
Phosphate	Less than 0.1		----
Silicon dioxide	8.4		0.280
Iron	Less than 0.5		----
Fluoride	10		0.523
P. alkalinity, in terms of calcium carbonate	--		
MO alkalinity, in terms of calcium carbonate	--		
Hardness, in terms of calcium carbonate	28		
Total dissolved solids	1,720		
Ammonia	0.7		
Lithium	Less than 0.5		
Barium	Less than 1.0		
Hexavalent chromium	Less than 0.01		
Arsenic	0.01		
Selenium	Less than 0.01		
Boron	0.4		
Hydroxide	Less than 0.1		

	MILLIGRAMS PER LITER
Aluminum	Less than 0.05
Copper	Less than 0.6
Cadmium	Less than 0.01
Lead	Less than 0.05
Manganese	Less than 0.05
Silver	Less than 0.01
Zinc	Less than 0.5
Mercury	Less than 0.01

pH 8.6
Specific conductance 2,350 micromhos per cc

MEMBERS OF:

AMERICAN ASS'N OF CEREAL CHEMISTS
AMERICAN CHEMICAL SOCIETY
AMERICAN OIL CHEMISTS' SOCIETY
ASS'N OF OFFICIAL RACING CHEMISTS
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SIGMA XI

THE INDUSTRIAL LABORATORIES COMPANY

CHEMIST

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CABLE ADDRESS COMTECO

COMMERCIAL TESTING & ENGINEERING CO.
GENERAL OFFICES: 220 NORTH LA SALLE STREET, CHICAGO, ILLINOIS 60601 · AREA CODE 312 726-8434

Reply to
Instrumental Analysis Division
14335 West 44th Avenue
Golden, Colorado 80401

Phone: 303-278-9521

12 November 74

Mr. Frank Haas
The Oil Shale Corporation
18200 West Hiway 72
Golden, Colorado 80401

Re: IAD #97-140-002-33

ANALYTICAL REPORT

Samples	TOC* mg/liter	Nitrate** mg/liter N	Free Ammonia** mg/liter N
ARCO et.al. SG #18 c-b @ 1380'	3	0.26	0.017
ARCO et.al. SG #18 960' Top of para Cr. 800 mΩ	3	<0.04	0.013
✓ ARCO et.al. Wtr. samples SG #19 Top of para Cr. @ 466'	4	0.28	0.012
✓ ARCO SG #19 @ 860'	4	0.21	0.018
✓ ARCO SG #19 TD @ 981'	3	0.34	0.040
SG #9 Top of Mining Zone 1285'	3	3.35	0.025
SG #18 Base of Mining Zone TD 1425.6 (800mΩ)	3	3.40	0.029
SG #9 Btm of Mining Zone @ 1360'	4	0.27	0.042
ARCO SG #9 Core Point @ 1200'	4	0.76	0.022
ARCO et.al. SG #9 @ 993' Top of parachute creek 800 mΩ	4	0.32	0.013

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Mr. Frank Haas
12 November 74
Page 2

* Test performed on samples marked 'Regular'
** Test performed on samples marked 'Hg for N'

Charles R. Wilson
Charles R. Wilson, Analyst

Approved by:
M. L. Jacobs, Ph.D.
Divisional Manger

CRW/dh

COMMERCIAL TESTING & ENGINEERING CO.
GENERAL OFFICES: 228 NORTH LA SALLE STREET, CHICAGO, ILLINOIS 60601 · AREA CODE 312 726-8434
Reply to INSTRUMENTAL ANALYSIS DIVISION, 14335 WEST AVENUE, GOLDEN, COLORADO, 80401, PHONE: 303-278-9521

To: Mr. Frank Haas
The Oil Shale Corporation
18200 West Hiway 72
Golden, Colorado 80401

Date: 8 November 74

Analyst: S. Sweeney

P. O. No.:

Sample No.: ARCO et.al. wtr samples SG #19 Top of para. cr. @ 466'

IAD No.: 97-140-002-33

CONCENTRATION IN µg/ml

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium		Terbium		Ruthenium		Vanadium	0.002
Thorium		Gadolinium		Molybdenum	0.01	Titanium	0.07
Bismuth		Europium		Niobium		Scandium	
Lead	0.03	Samarium		Zirconium		Calcium	*
Thallium		Neodymium		Yttrium		Potassium	*
Mercury	**0.0001	Praseodymium		Strontium	0.2	Chlorine	*
Gold		Cerium	0.006	Rubidium	0.009	Sulfur	*
Platinum		Lanthanum	0.004	Bromine	0.006	Phosphorus	0.1
Iridium		Barium	0.2	Selenium		Silicon	*
Osmium		Cesium		Arsenic		Aluminum	2
Rhenium		Iodine		Germanium		Magnesium	*
Tungsten		Tellurium		Gallium		Sodium	*
Tantalum		Antimony		Zinc	0.02	Fluorine	*
Hafnium		Tin		Copper	0.02	Oxygen	NR
Lutetium		Indium	STD	Nickel	0.007	Nitrogen	NR
Ytterbium		Cadmium		Cobalt	0.002	Carbon	NR
Thulium		Silver		Iron	0.7	Boron	0.01
Erbium		Palladium		Manganese	0.06	Beryllium	
Holmium		Rhodium		Chromium	0.005	Lithium	0.7
Dysprosium						Hydrogen	NR

NR – Not Reported
All elements not reported <0.006 µg/ml
* Not reported upon request
** Flameless Atomic Absorption

Approved: M J Jacobs

COMMERCIAL TESTING & ENGINEERING CO.

GENERAL OFFICES: 228 NORTH LA SALLE STREET, CHICAGO, ILLINOIS 60601 · AREA CODE 312 726-8434
Reply to INSTRUMENTAL ANALYSIS DIVISION, 14335 WEST AVENUE, GOLDEN, COLORADO, 80401, PHONE: 303-278-9521

To: Mr. Frank Haas
The Oil Shale Corporation
18200 West Hiway 72
Golden, Colorado 80401

Date: 8 November 74

Analyst: S. Sweeney

P. O. No.:

Sample No.: ARCO SG #19 @ 860'

IAD No.: 97-140-002-33

CONCENTRATION IN µg/ml

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium		Terbium		Ruthenium		Vanadium	0.003
Thorium		Gadolinium		Molybdenum	0.07	Titanium	0.2
Bismuth		Europium		Niobium		Scandium	
Lead	0.03	Samarium		Zirconium		Calcium	*
Thallium		Neodymium		Yttrium		Potassium	*
Mercury	**0.0001	Praseodymium		Strontium	0.4	Chlorine	*
Gold		Cerium		Rubidium	0.01	Sulfur	*
Platinum		Lanthanum	0.005	Bromine	0.007	Phosphorus	0.2
Iridium		Barium	0.2	Selenium		Silicon	*
Osmium		Cesium		Arsenic	0.005	Aluminum	0.7
Rhenium		Iodine		Germanium		Magnesium	*
Tungsten		Tellurium		Gallium		Sodium	*
Tantalum		Antimony		Zinc	0.03	Fluorine	*
Hafnium		Tin		Copper	0.03	Oxygen	NR
Lutetium		Indium	STD	Nickel	0.02	Nitrogen	NR
Ytterbium		Cadmium		Cobalt	0.003	Carbon	NR
Thulium		Silver		Iron	0.9	Boron	***0.3
Erbium		Palladium		Manganese	0.02	Beryllium	
Holmium		Rhodium		Chromium	0.005	Lithium	1
Dysprosium						Hydrogen	NR

NR – Not Reported
All elements not reported <0. 008 µg/ml
* Not reported upon request
** Flameless Atomic Absorption
*** Heterogeneous

Approved:

COMMERCIAL TESTING & ENGINEERING CO.

Reply to

GENERAL OFFICES: 228 NORTH LA SALLE STREET, CHICAGO, ILLINOIS 60601 · AREA CODE 312 726-8434
INSTRUMENTAL ANALYSIS DIVISION, 14335 WEST AVENUE, GOLDEN, COLORADO, 80401, PHONE: 303-278-9521

To: Mr. Frank Haas
The Oil Shale Corporation
18200 West Hiway 72
Golden, Colorado 80401

Date: 8 November 74

Analyst: S. Sweeney

P. O. No.:

Sample No.: ARCO SG #19 TD @981'

IAD No.: 97-140-002-33

CONCENTRATION IN μg/ml

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium		Terbium		Ruthenium		Vanadium	< 0.001
Thorium		Gadolinium		Molybdenum	0.009	Titanium	0.05
Bismuth		Europium		Niobium		Scandium	<0.001
Lead	0.01	Samarium		Zirconium	0.003	Calcium	*
Thallium		Neodymium		Yttrium		Potassium	*
Mercury	**0.0001	Praseodymium		Strontium	0.3	Chlorine	*
Gold		Cerium	0.001	Rubidium	0.005	Sulfur	*
Platinum		Lanthanum	0.001	Bromine	0.007	Phosphorus	0.02
Iridium		Barium	0.2	Selenium		Silicon	*
Osmium		Cesium		Arsenic	0.005	Aluminum	0.09
Rhenium		Iodine		Germanium		Magnesium	*
Tungsten		Tellurium		Gallium		Sodium	*
Tantalum		Antimony		Zinc	0.006	Fluorine	*
Hafnium		Tin		Copper	0.01	Oxygen	NR
Lutetium		Indium	STD	Nickel	0.01	Nitrogen	NR
Ytterbium		Cadmium		Cobalt	0.005	Carbon	NR
Thulium		Silver		Iron	0.2	Boron	0.04
Erbium		Palladium		Manganese	0.002	Beryllium	
Holmium		Rhodium		Chromium	0.002	Lithium	0.7
Dysprosium						Hydrogen	NR

NR – Not Reported
All elements not reported <0.002 μg/ml
* Not reported upon request
** Flameless Atomic Absorption

Approved:

HAZEN RESEARCH, INC.
4601 Indiana Street
Golden, Colorado 80401

Mr. Frank Haas
The Oil Shale Corporation

Date: November 27, 1974
HRI Project No. 535
HRI Series No. 7515
Samples received: Oct. 22, 1974

Page 2

REPORT OF ANALYSIS

Analysis No.	Sample Description	pCi/l α Total	±	α Precision*	pCi/l β Total	±	β Precision*	pCi/l Ra^{226}	±	Precision*
7515-21	9 Bottom-1360'	1.5	±	2.7	0	±	15			
-22	Top of parachute 9 Creek-993'	3.4	±	2.1	0	±	13			
-23	Top of mining zone 9-1285'	5.7	±	2.7	0	±	14	0.9	±	0.6
-24	A-10 67'	2.3	±	2.5	0	±	14			
-25	A-11 66'	2.2	±	2.6	0	±	14			
-26	A-11 66'	5.0	±	3.2	0	±	15	0	±	0.3
-27	A-12 78'	1.6	±	2.4	0	±	14			
-28	18-Base 1425.6'	4.0	±	2.2	0	±	13			
-29	18-1380'	1.8	±	1.9	0	±	13			
-30	Top of para. 18-960'	0.6	±	1.7	0	±	13			
-31 ✓	Top of para. 19-466'	2.8	±	2.1	0	±	13			
-32 ✓	19-860'	0.7	±	2.6	0	±	15			
-33 ✓	19-TD-981'	0	±	3.4	0	±	33			

*Variability of the radioactive disintegration process (counting error) at the 95% confidence level, 1.96σ

By: John C. Jarvis
John C. Jarvis
Manager, Analytical Laboratory

ljb

BASELINE WATER QUALITY

A ground water quality sample taken during drilling is simply the first sample taken at that particular depth for that particular hole; the drilling samples primarily reflect changes in water quality versus DEPTH as we first enter the hole. Superimposed upon these drilling sampling requirements are the requirements of baseline monitoring, or measuring the fluctuations in water quality versus TIME. In many cases the initial water quality samples taken during drilling to study depth variation will also be used as the first samples in the baseline monitoring study of time variation. In a few cases we have taken special samples immediately after the cessation of drilling and completion of the hole to start our baseline monitoring.

Water quality data from samples taken during drilling are reported in the previous section. Of the samples collected after drilling and completion operations had ceased, only the analysis of SG-18a had been completed on November 30, 1974. That analysis is presented in this section.

TABLE II B-15

BASELINE WATER QUALITY ANALYSIS
MONITORING WELL

Well Number: 18a, at 1330' T.D.
Location: See fig. II B-1

	DATE SAMPLE TAKEN	11/1/74				
	Element Measured (+)					
1.	Aluminum	0.5				
2.	Ammonia					
3.	Arsenic	.02				
4.	Barium	.03				
5.	Beryllium	<.007				
6.	Bicarbonate	471				
7.	Bismuth	<.007				
8.	Boron	1.4				
9.	Cadmium	<.007				
10.	Calcium	24				
11.	Carbonate	0				
12.	Cerium	<.007				
13.	Chloride	3				
14.	Chrome, Hexavalent					
15.	Cobalt	.001				
16.	Conductivity, Specific					
17.	Copper	.02				
18.	Fluoride	190				
19.	Gallium	<.007				
20.	Hardness, Total					
21.	Hydroxide					
22.	Iron	0.02				
23.	Lead	<.02				
24.	Lithium	.3				
25.	Magnesium	30				
26.	Manganese	0.04				
27.	Mercury	.0024				
28.	Molybdenum	0.03				
29.	Nickel	0.005				
30.	Nitrate	0.22				
31.	pH	8.2				
32.	Phosphate, Total					
33.	Potassium	0.4				
34.	Selenium	<.007				
35.	Silica	23				
(*)36.	Silver					
37.	Sodium	135				
38.	Solids, Dissolved	536				
39.	Strontium	0.3				
40.	Sulfate	84				
41.	Titanium	0.04				
42.	Vanadium	0.001				
43.	Yttrium	0.007				
44.	Zinc	0.03				
45.	Zirconium	<.007				
46.	Radioactivity					
	Gross Alpha (pcl)	8.0				
	Radium 226*	0.1				
	Gross Beta (pcl)	0				
	Thorium 230**					
	Uranium**					
47.	Total Organic Carbon (TOC) If TOC > 10 mg/l then measure	<1				
	Dissolved Organic Carbon					
	Suspended Organic Carbon					
	Phenols					
	Sulfate, Acid Extraction					
	Nitrogen, Base Extraction					

(*) Not required
* Required if gross alpha is greater than 4 picocuries per liter (pcl).
** Required if gross beta is greater than 100 picocuries per liter (pcl).
(+) Unless otherwise stated, all units are mg/l.

GEOPHYSICAL LOG DATA

Only two types of geophysical logs are required to be run on test holes. They are the sonic log and resistivity log. As of September 12, 1974, the latter shall be either a standard electric resistivity log or focussed electric resistivity log rather than the induction-type log. Table II B-16 shows the individual geophysical logs completed as of November 30, 1974 on each well on Tract C-b.

Resistivity logs are used for the definition of formations, for correlations, and for qualitative and quantitative analysis of formations in terms of fluid saturation and porosity. Most wells have had a laterolog run to satisfy this requirement; the Birdwell standard electrical survey was run on AT-1a and SG-10.

Sonic logging fundamentally involves measuring the time required for a sound wave to travel through a definite length of formation. The sonic log is quite detailed and is a good log for correlation purposes. Birdwell velocity logs (sonic) were run on wells AT-1a and SG-10; on all other wells Schlumberger borehole compensated sonic log-gamma ray logs were run.

Logs run and not required are the gamma ray, neutron density, temperature, micro-seismograph, and caliper logs.

TABLE II B-16

GEOPHYSICAL LOGS

	Well No.											
Geophysical Log Type	A.T.1	A.T.1a	A.T.1b	A.T.1d	S.G.10	S.G.11	S.G.18	S.G.19	Cb-1	Cb-2	Cb-3	Cb-4
Schlumberger:												
B-Borehole Compensated Sonic	X		X	X		X	X	X				
L-Laterolog	X		X	X		X	X	X				
FD-Formation Density	X		X	X			X	X				
ND-Neutron Formation Density	X		X	X								
T-Temperature	X	X	X	X	X	X	X	X				
CBL-Cement Bond Log				(X)		(X)				(X)		(X)
Birdwell:												
V-Velocity, 3-Dimensional		X			X							
E-Electric		X			X							
D-Density		X			X							
N-Nuclear		X			X							
C-Caliper		X			X							
T'-Temperature		X			X				X	X	X	X
Welex:												
W-Micro-Seismogram		(X)			(X)							
McCullough:												
TM-Temperature			(X)									

( ) - Field copies only of the geolog are available. Films are not complete for distribution.

Ti
Ma
Equi
Recor
Witnes

SWS-1383-E

Schlumberger

BOREHOLE COMPENSATED SONIC LOG · GAMMA RAY

COUNTY RIO BLANCO
FIELD or LOCATION SORGUM GULCH
WELL AQUIFER NO. 1
COMPANY ATLANTIC RICHFIELD

COMPANY ATLANTIC RICHFIELD COMPANY

WELL SORGUM GULCH AQUIFER NO. 1

FIELD

COUNTY RIO BLANCO STATE COLORADO

LOCATION

Sec. 7 Twp. 3S Rge. 96W

Other Services:
DIL TEMP.
FDC-GR
CNL-GR

Permanent Datum: GL, Elev. 6909
Log Measured From GL, 0 Ft. Above Perm. Datum
Drilling Measured From GL

Elev.: K.B. ----
D.F. ----
G.L. 6909

Date	7-5-74							
Run No.	ONE							
Depth—Driller	1338							
Depth—Logger	1338							
Btm. Log Interval	1328							
Top Log Interval	410							
Casing—Driller	13-3/8 @166		@		@		@	
Casing—Logger	----							
Bit Size	12-1/4							
Type Fluid in Hole	WATER							
Dens. | Visc.								
pH | Fluid Loss		ml		ml		ml		ml
Source of Sample								
R_m @ Meas. Temp.	@	°F	@	°F	@	°F	@	°F
R_{mf} @ Meas. Temp.	@	°F	@	°F	@	°F	@	°F
R_{mc} @ Meas. Temp.	@	°F	@	°F	@	°F	@	°F
Source: R_{mf} | R_{mc}								
R_m @ BHT	@	°F	@	°F	@	°F	@	°F
Time Since Circ.								
Max. Rec. Temp.	68	°F		°F		°F		°F
Equip. | Location	7674	VERNAL						
Recorded By	HAUGAARD							
Witnessed By	TATE							

The well name, location and borehole reference data were furnished by the customer.

FOLD HERE

REMARKS SO #07174

Changes in Mud Type or Additional Samples				
Date | Sample No.				
Depth—Driller				
Type Fluid in Hole				
Dens. | Visc.				
ph | Fluid Loss		ml		
Source of Sample				
R_m @ Meas. Temp.	@	°F	@	°F
R_{mf} @ Meas. Temp.	@	°F	@	°F
R_{mc} @ Meas. Temp.	@	°F	@	°F
Source: R_{mf} | R_{mc}				
R_m @ BHT	@	°F	@	°F
R_{mf} @ BHT	@	°F	@	°F
R_{mc} @ BHT	@	°F	@	°F

Scale Changes

Type Log	Depth	Scale Up Hole	Scale Down Hole

Equipment Data

Run No.	Tool Type	Pad Type	Tool Pos.	Other

C.D.: S.O.: RUBBER FIN

Equip. Used: CART. No. EA-41

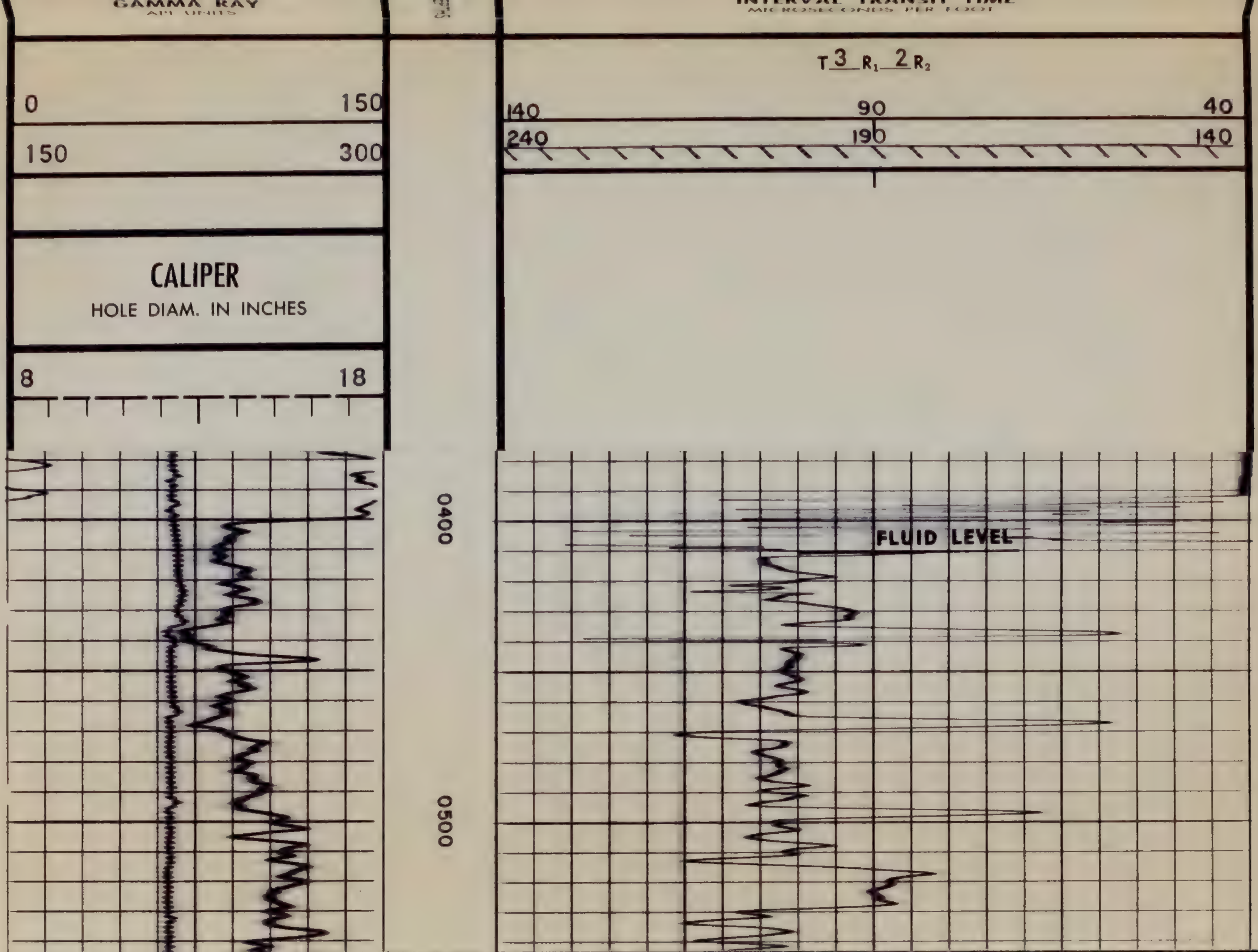
PANEL No. JG-130

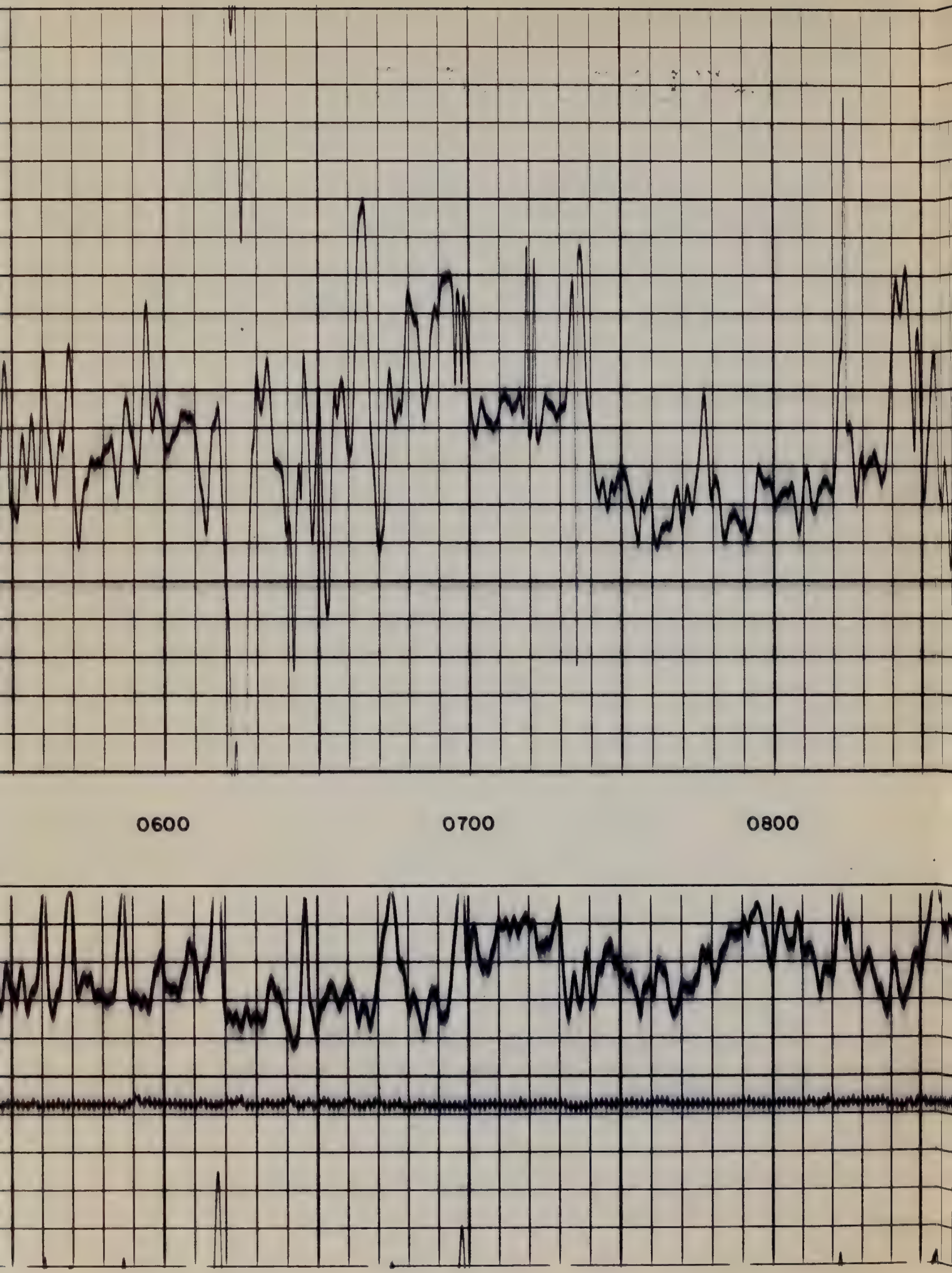
SONDE No. KG-161

CALIBRATION:	BACKGND. CPS.	SOURCE CPS.	GALV. INCR. DIVISIONS	SENS. TAP (FOR CAL.)	SENS. TAP (RECORD)	TIME CONST.	RECORDING SPEED (FT./MIN.)
GAMMA RAY:	100	400				1	60

$$\text{Velocity (feet per second)} = \frac{1{,}000{,}000}{\text{Interval Transit Time (microseconds per foot)}}$$

GAMMA RAY API UNITS	DEPTHS	INTERVAL TRANSIT TIME MICROSECONDS PER FOOT


GAMMA RAY
API UNITS
INTERVAL TRANSIT TIME
MICROSECONDS PER FOOT
T 3 R₁ 2 R₂
0
150
150
300
140
90
40
240
190
140
CALIPER
HOLE DIAM. IN INCHES
8
18
0400
0500
FLUID LEVEL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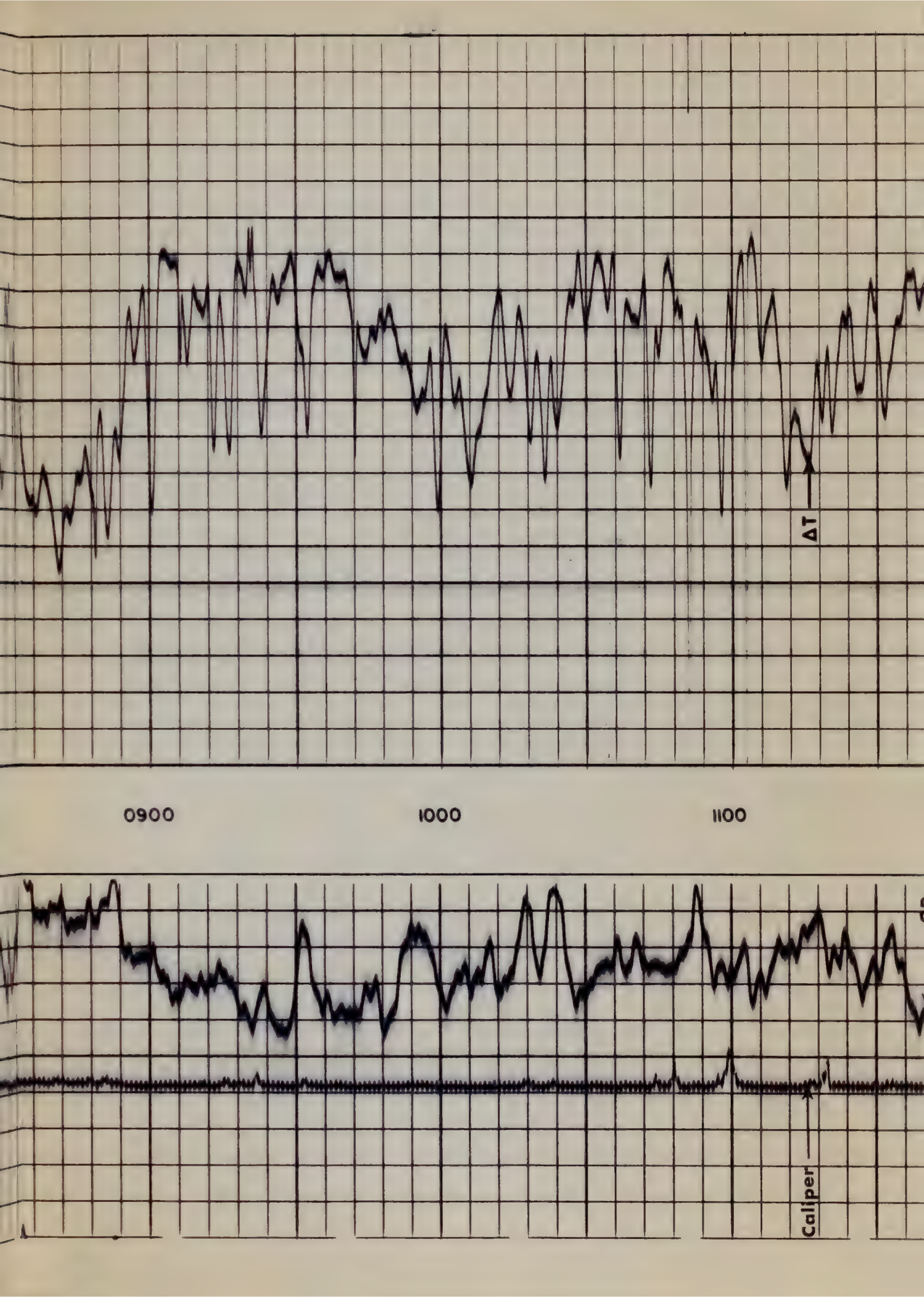
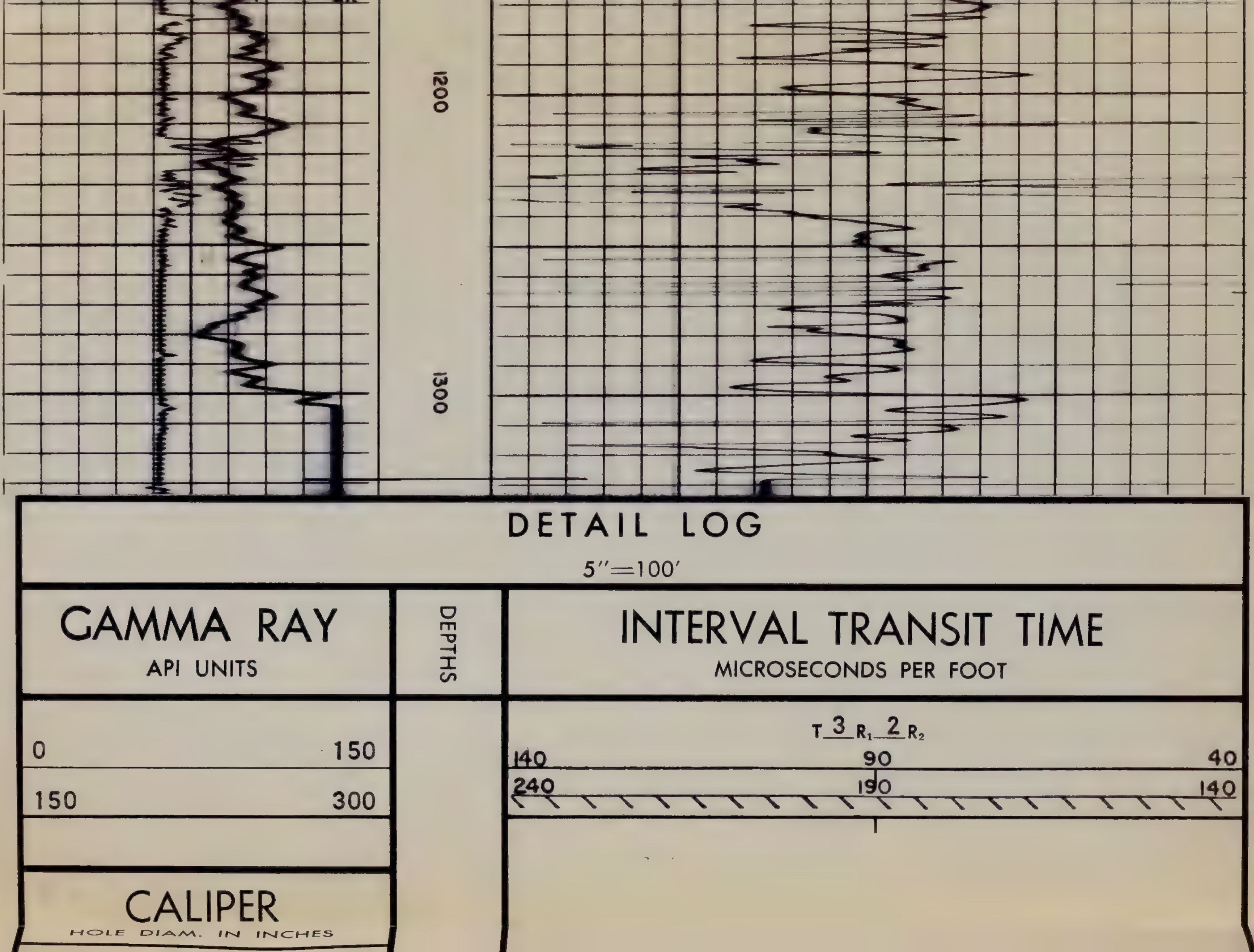
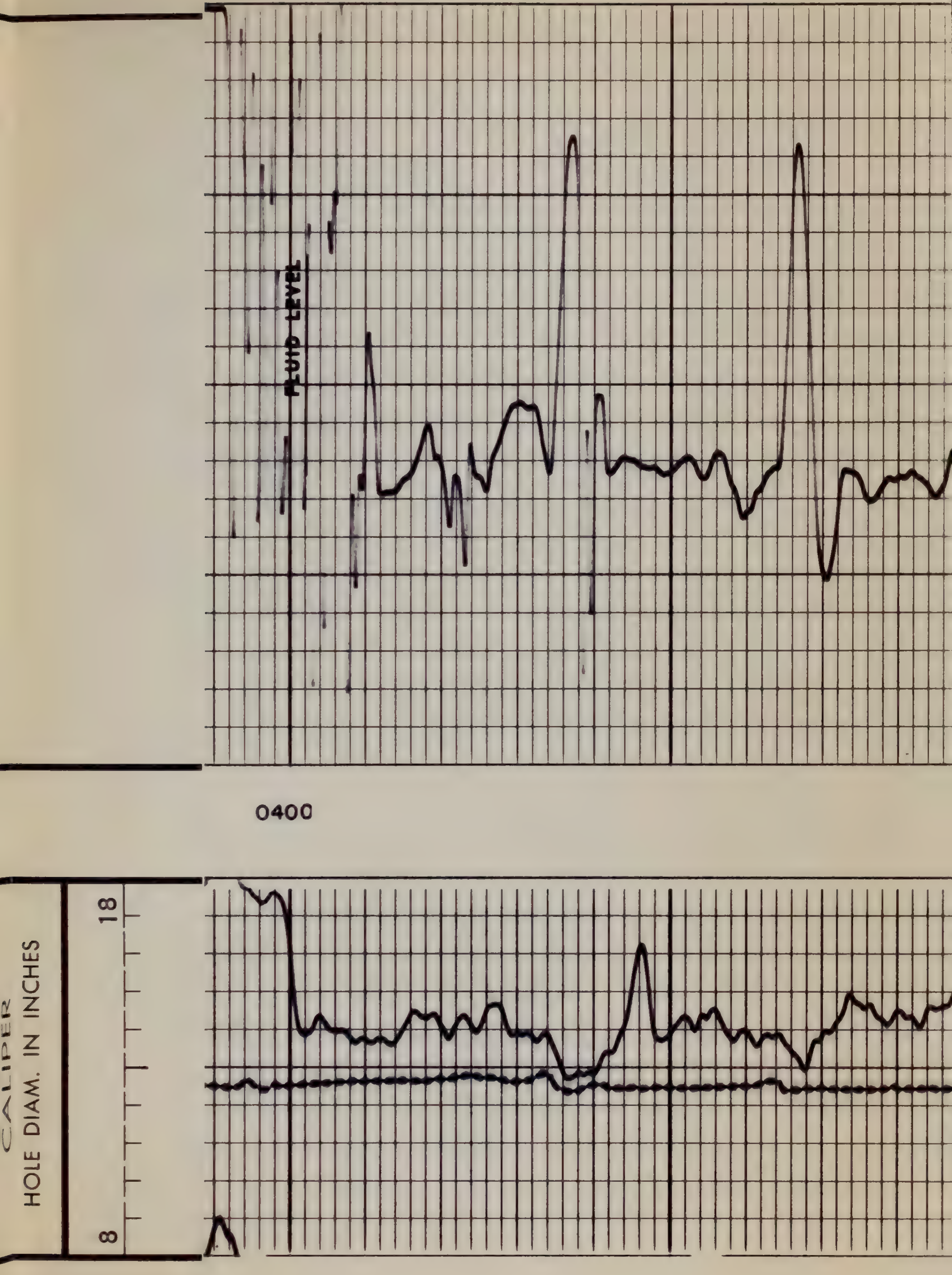
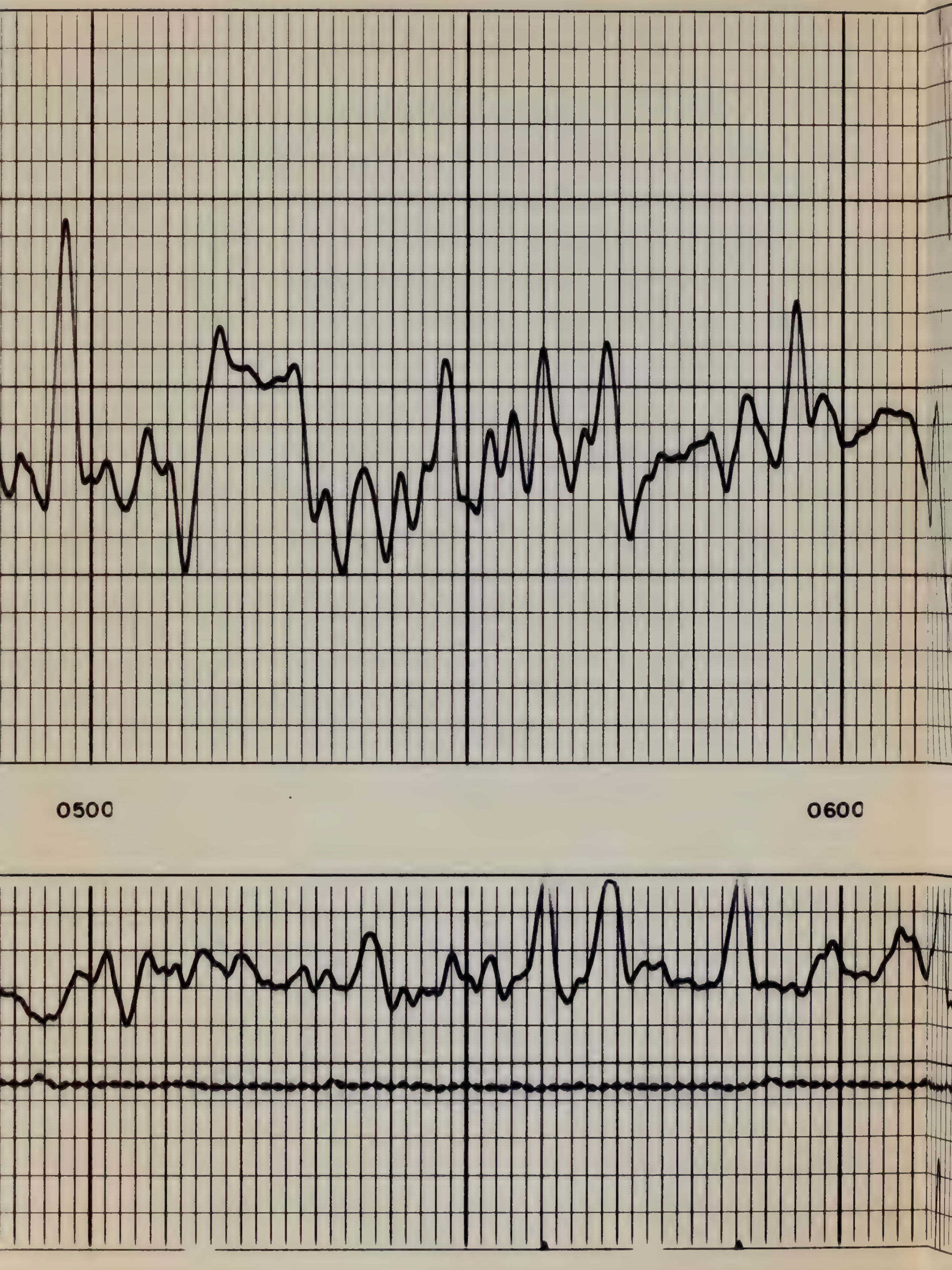
0700
0800


ΔT
0900
1000
1100
Caliper


1200
1300
DETAIL LOG
5″=100′
GAMMA RAY
API UNITS
0
150
150
300
CALIPER
HOLE DIAM. IN INCHES
DEPTHS
INTERVAL TRANSIT TIME
MICROSECONDS PER FOOT
T 3 R1 2 R2
140
90
40
240
190
140


FLUID LEVEL
0400
CALIPER
HOLE DIAM. IN INCHES
18
8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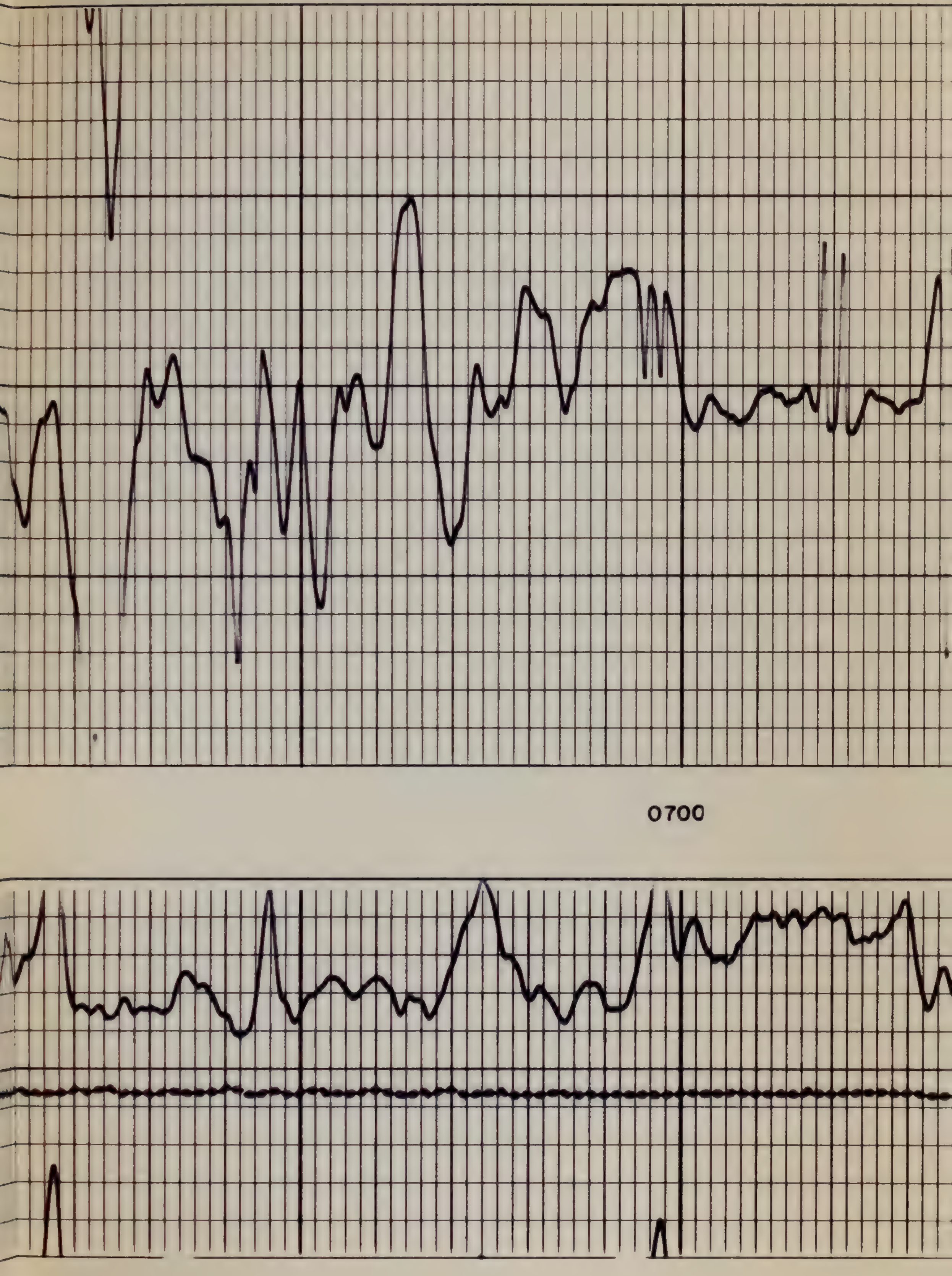
0600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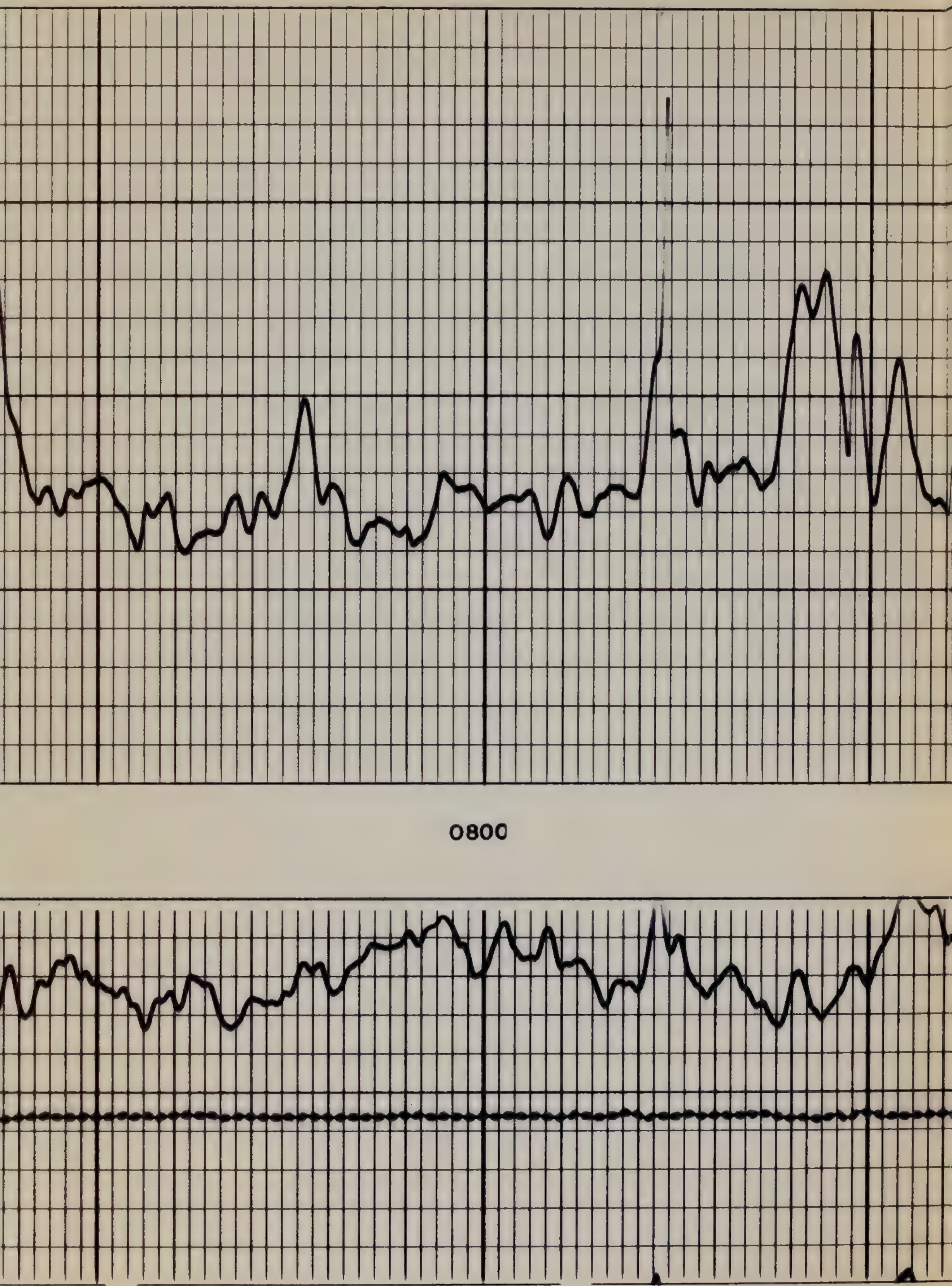
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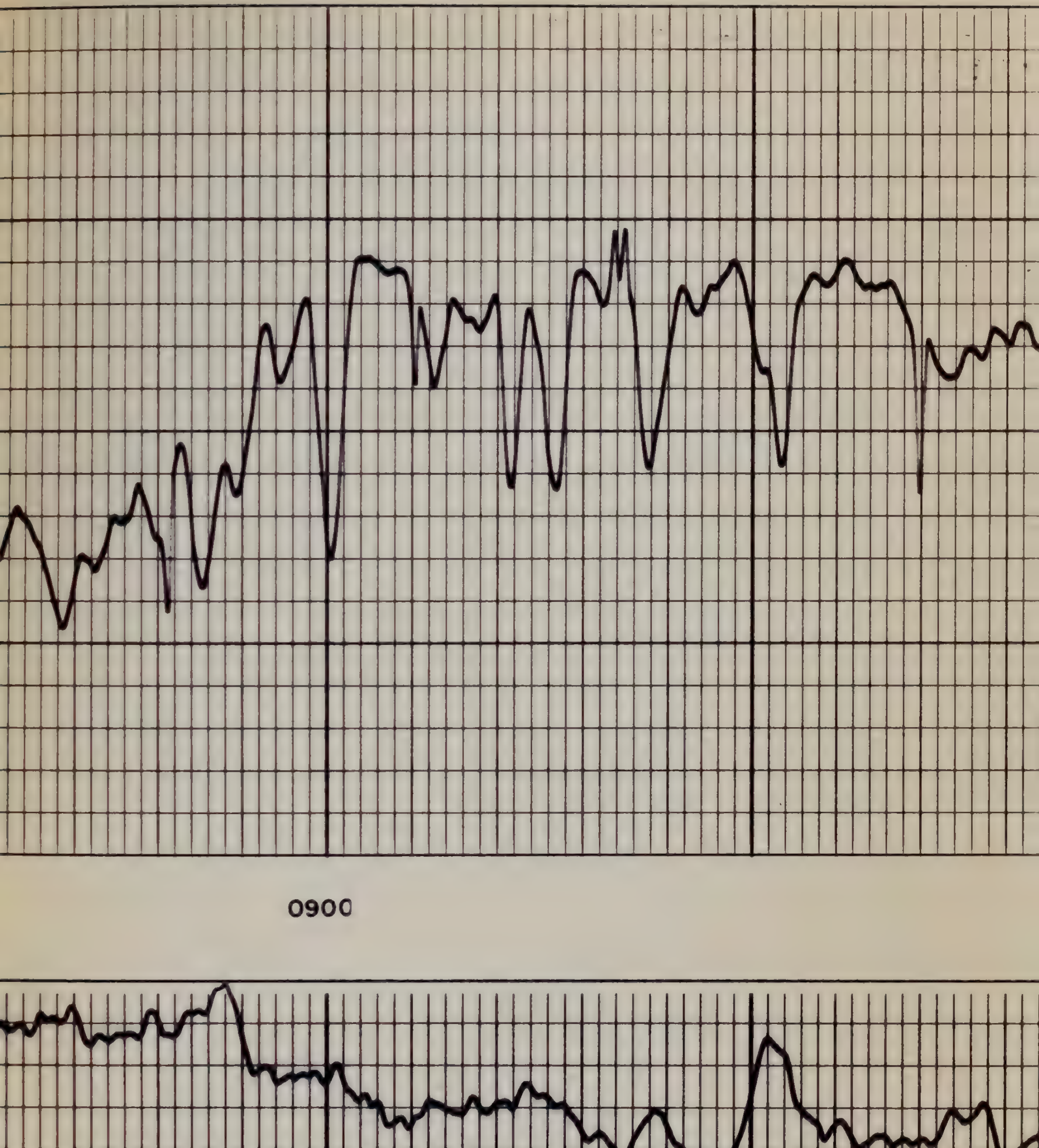
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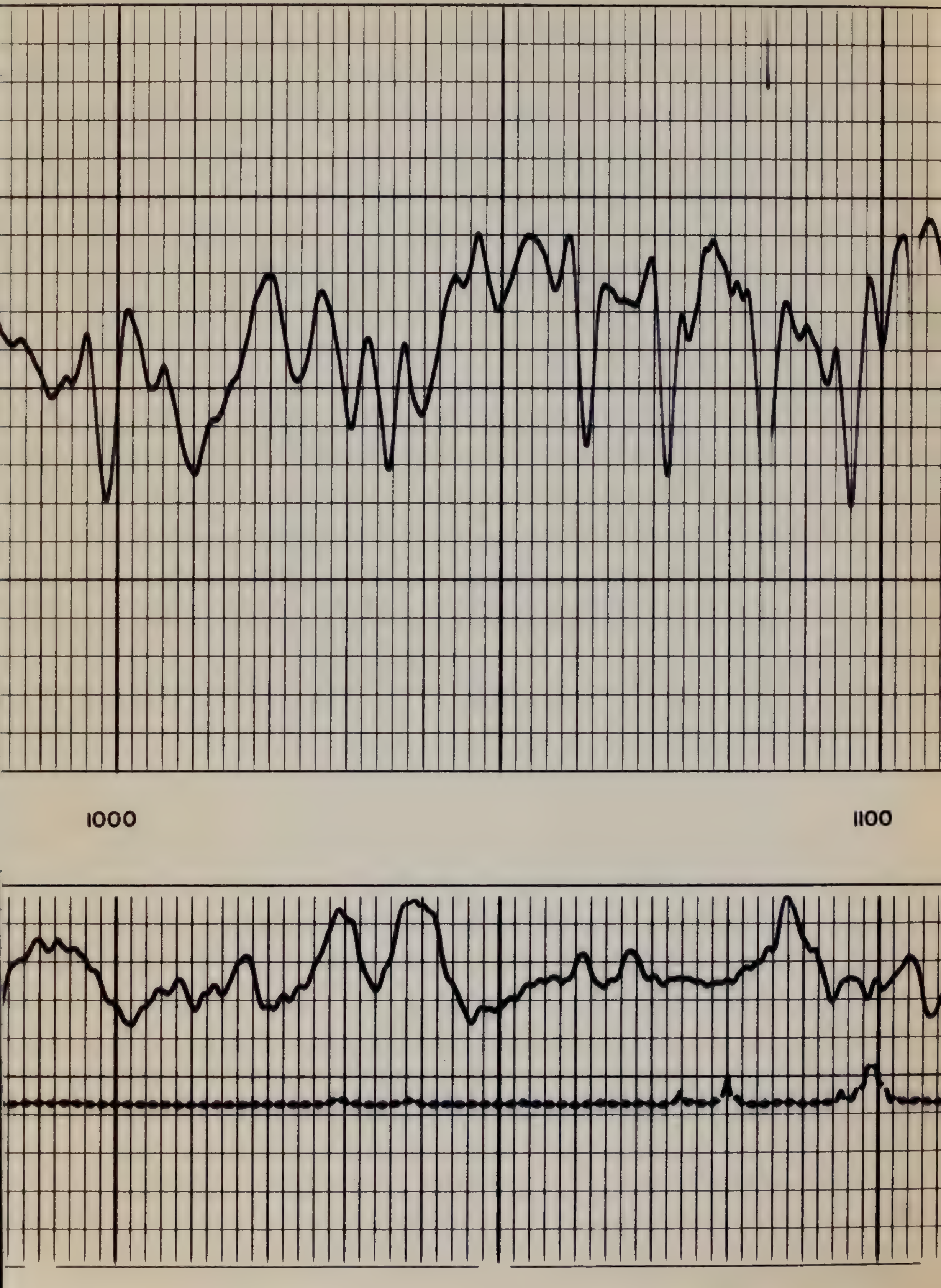
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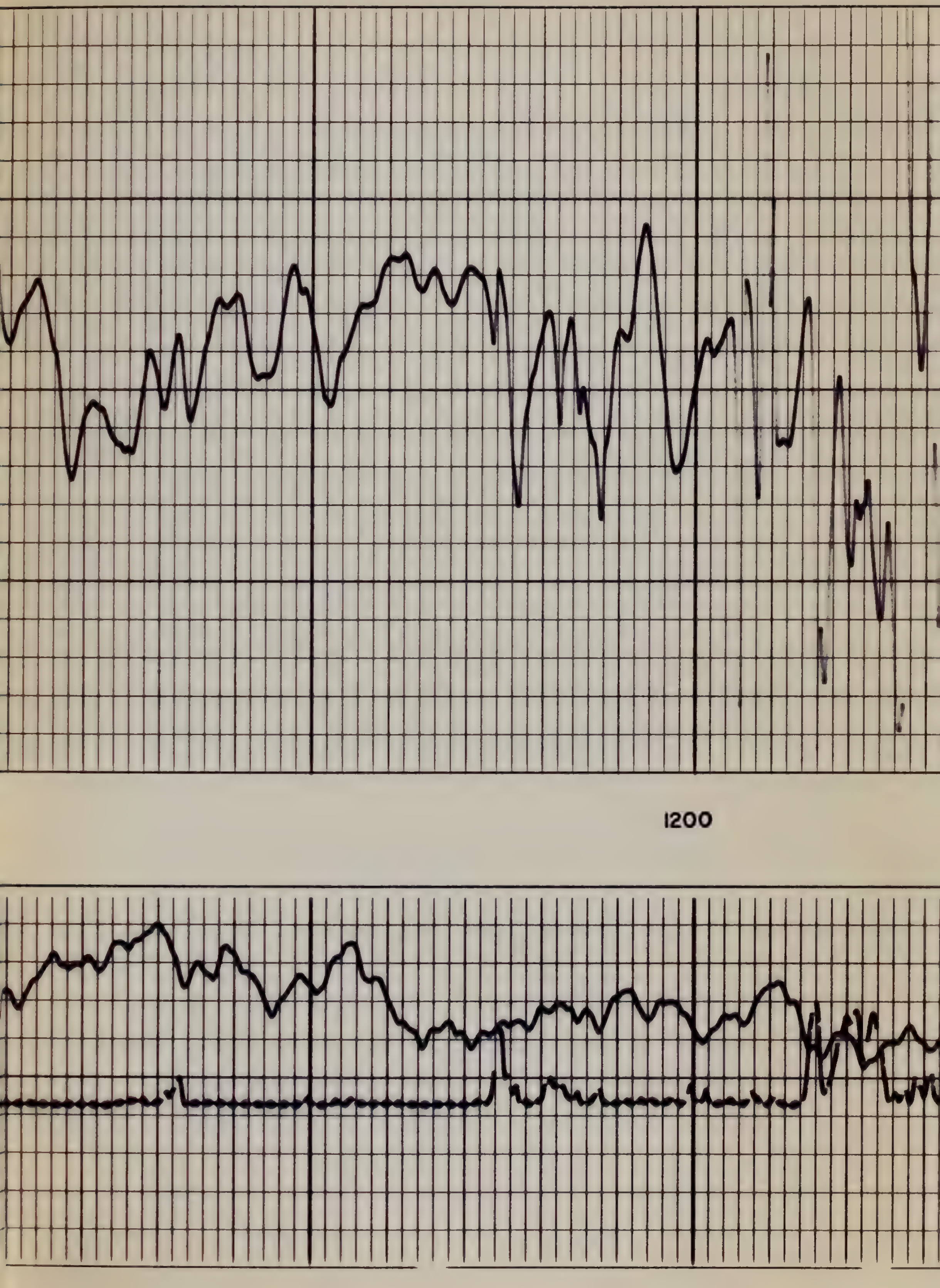
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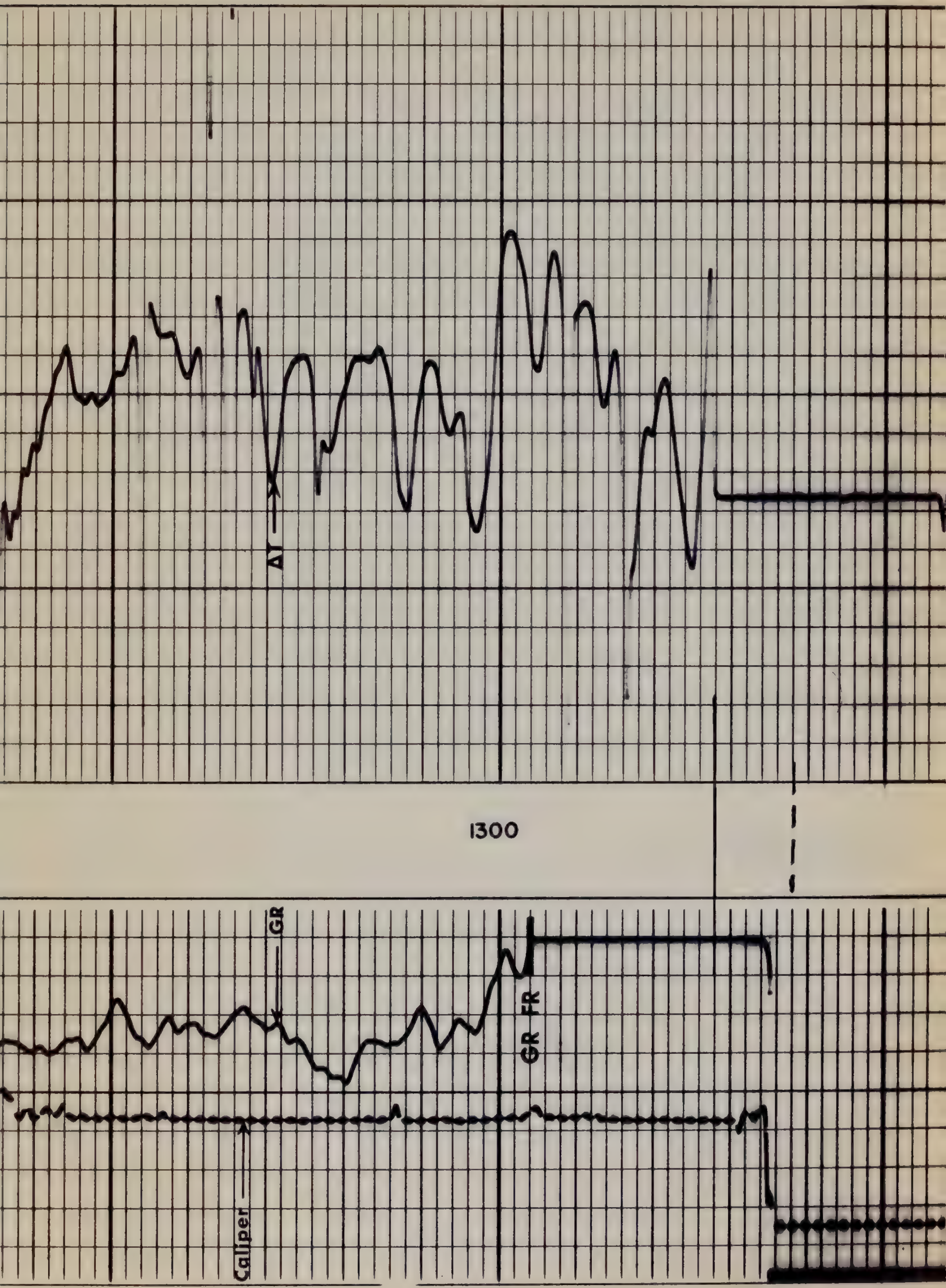
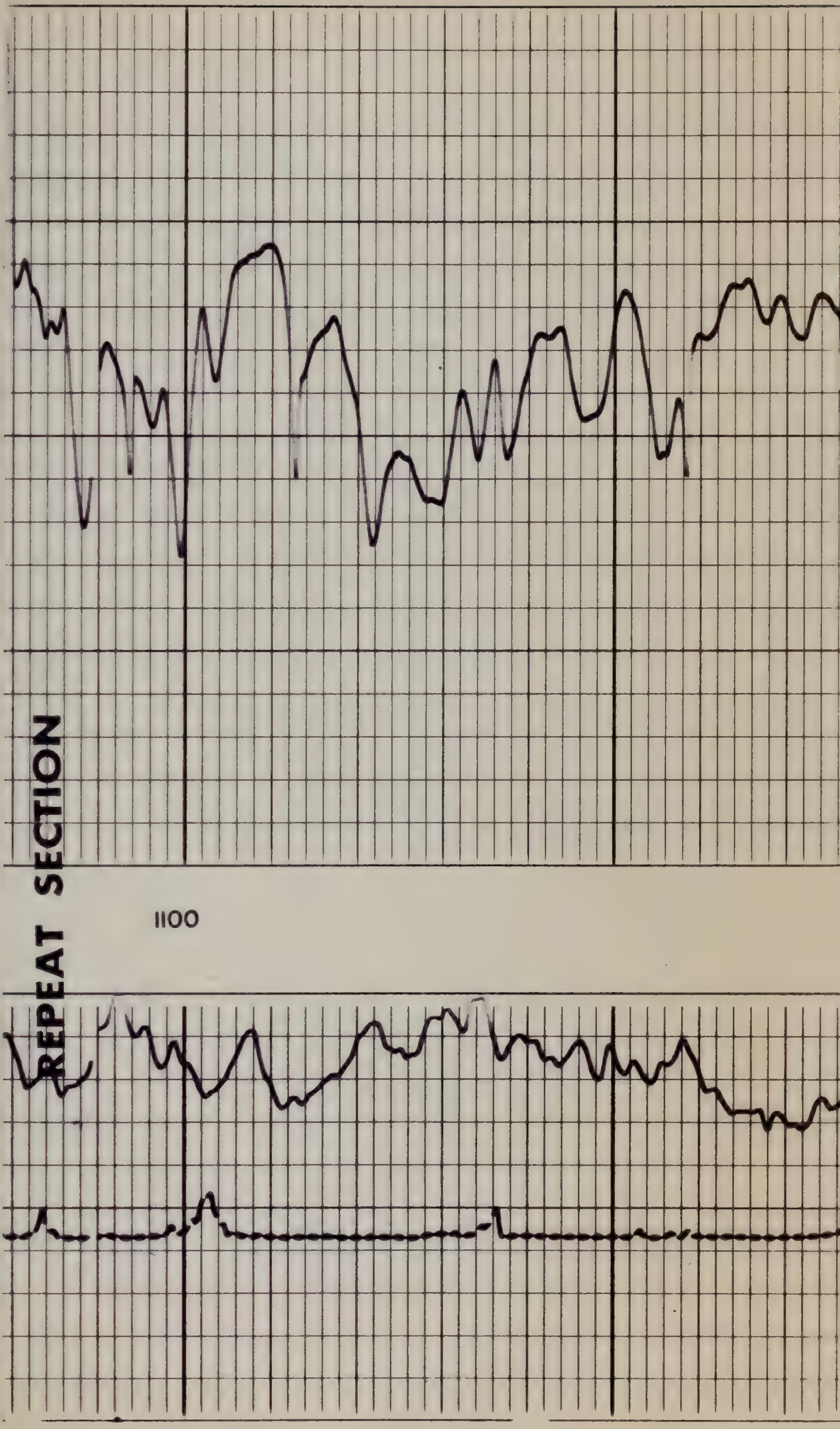

AT
1300
GR
GR FR
Caliper


REPEAT SECTION
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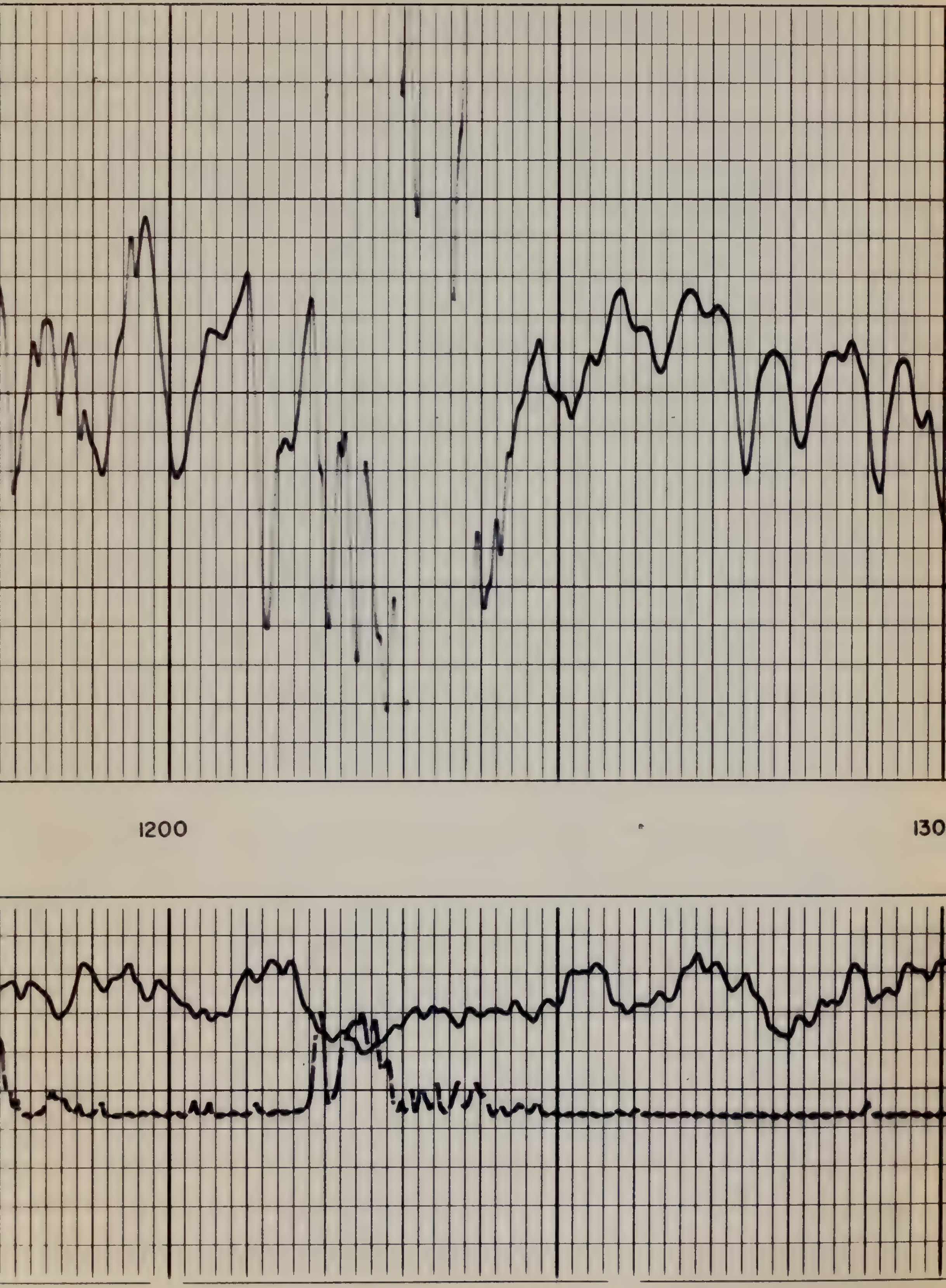
1200
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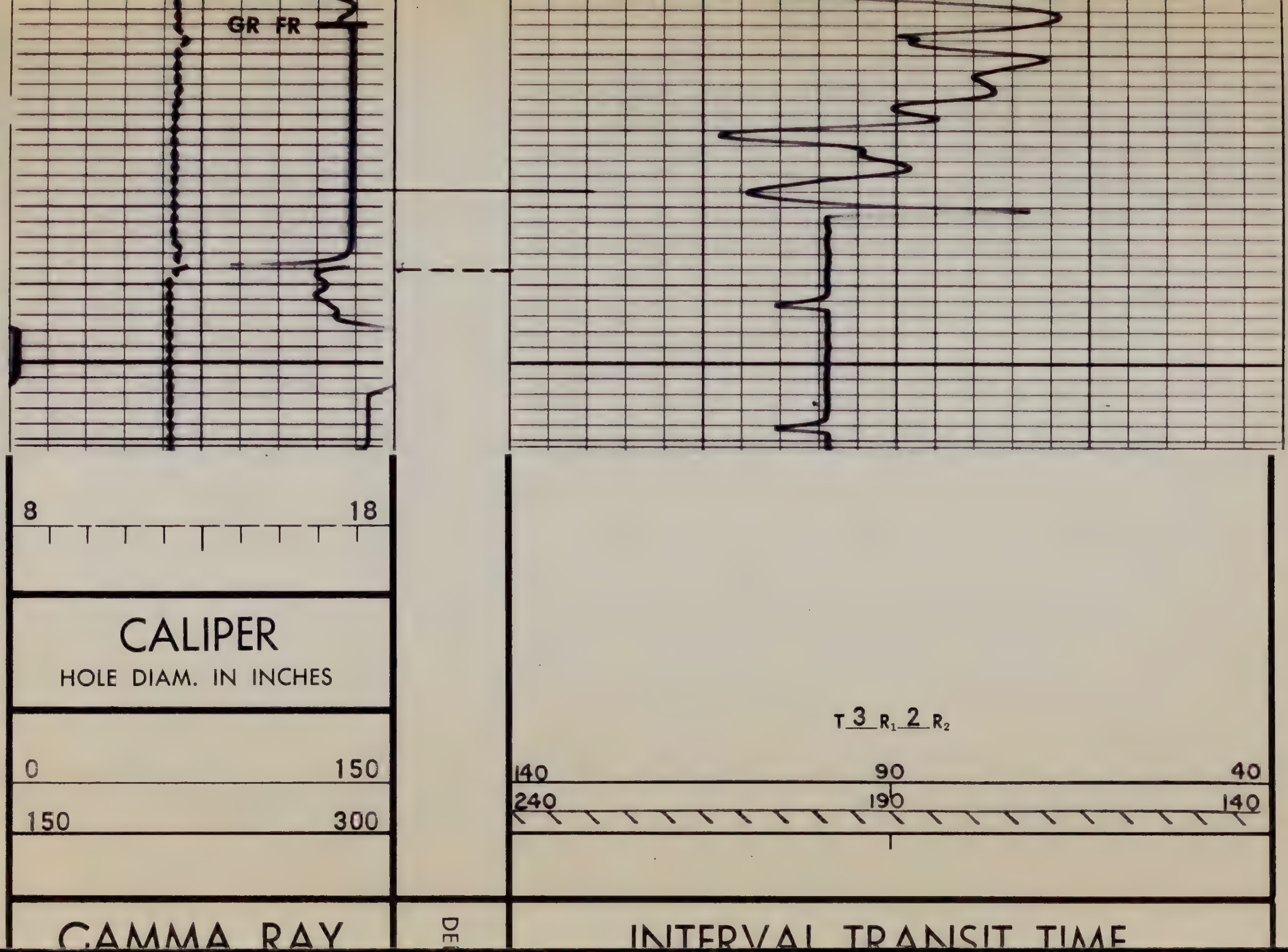

GR FR
8
18
CALIPER
HOLE DIAM. IN INCHES
0
150
150
300
GAMMA RAY
DE
T 3 R₁ 2 R₂
140
90
40
240
190
140
INTERVAL TRANSIT TIME

GAMMA RAY API UNITS	PTHS	INTERVAL TRANSIT TIME MICROSECONDS PER FOOT

COMPANY ATLANTIC RICHFIELD COMPANY

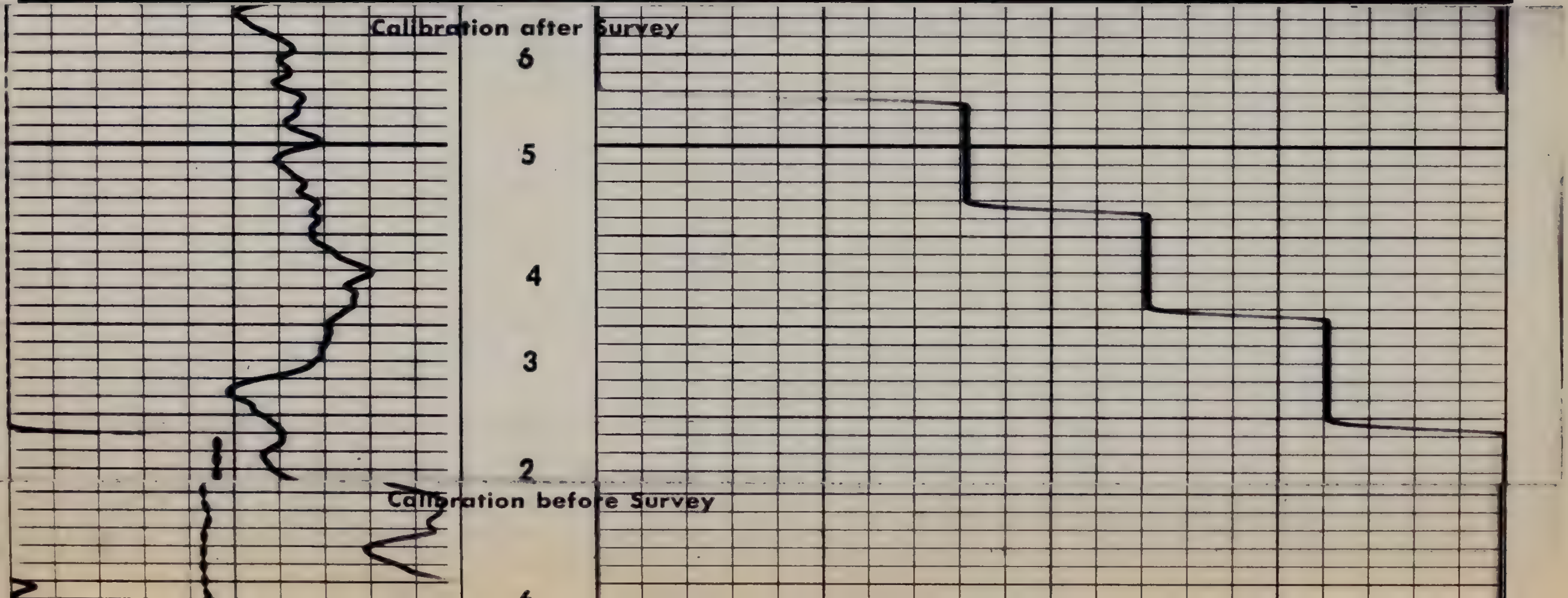
WELL SORGUM GULCH AQUIFER NO. 1

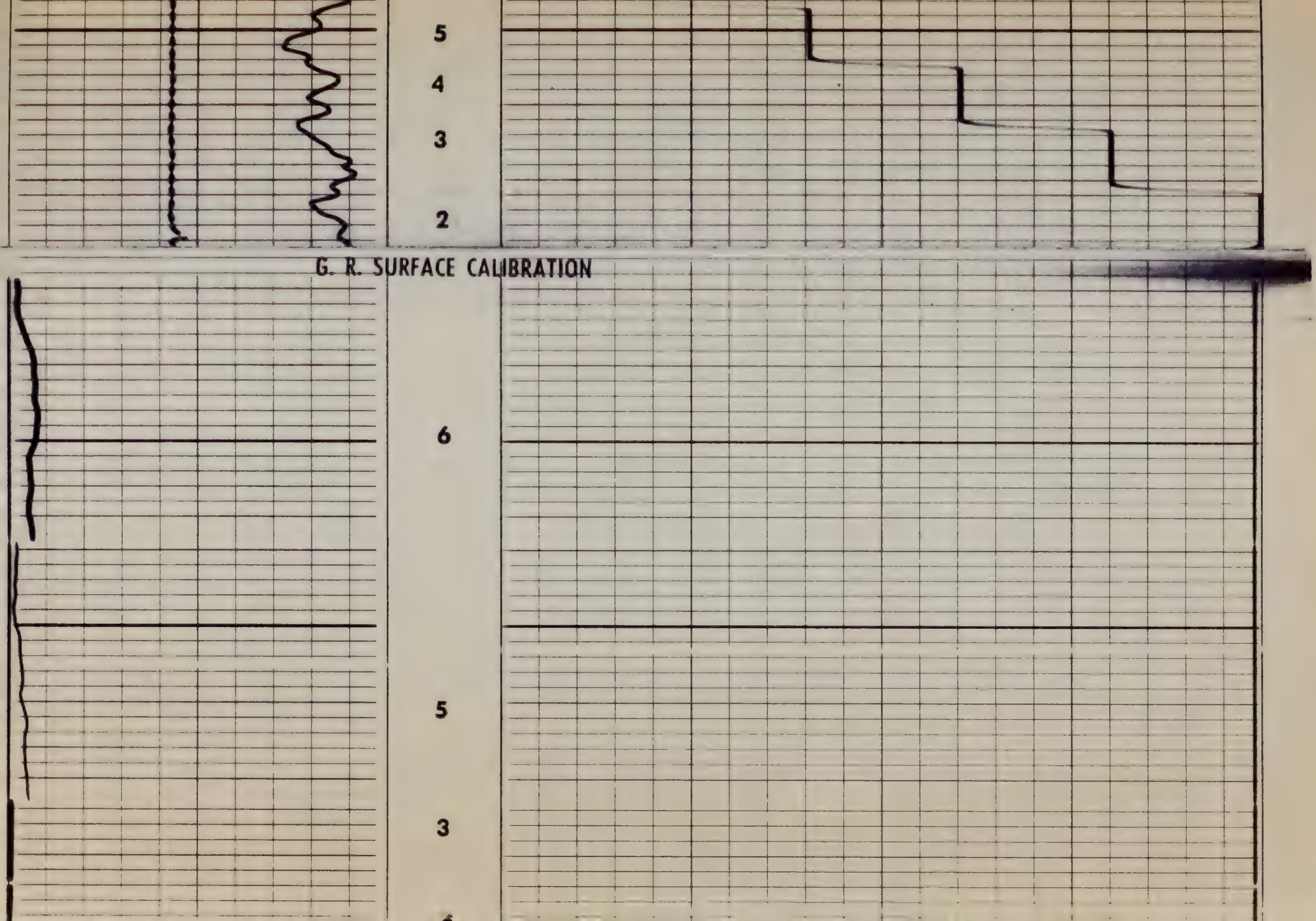
FIELD

COUNTY RIO BLANCO STATE COLORADO

SCHL. FR 1328
SCHL. TD 1338
DRLR TD 1338
Elev:
KB ----
DF ----
GL 6909

CALIBRATION DATA




5
4
3
2
G. R. SURFACE CALIBRATION
6
5
3

1

BOREHOLE COMPENSATED SONIC CALIBRATION CODING

1. MECHANICAL ZERO
2. 40 μ SEC/FT
3. 60 μ SEC/FT
4. 80 μ SEC/FT
5. 100 μ SEC/FT
6. 140 μ SEC/FT

GAMMA RAY CALIBRATION CODING

1. MECHANICAL ZERO
2. ELECTRICAL ZERO
3. RECORDER SENSITIVITY
4. MEMORIZER ADJUSTMENT
5. BACKGROUND
6. CALIBRATION

↑

CALIBRATION DATA

COMPANY ATLANTIC RICHFIELD COMPANY

WELL SORGUM GULCH AQUIFER NO.1

SCHL. FR 1328

SCHL. TD 1338

FIELD

COUNTY RIO BLANCO STATE COLORADO

Elev:
KB ----
DF ----
GL 6909

Schlumberger

DUAL INDUCTION - LATEROLOG
WITH LINEAR CORRELATION LOG

COUNTY RIO BLANCO
FIELD or LOCATION SORGUM GULCH
WELL AQUIFER NO. 1
COMPANY ATLANTIC RICHFIELD

COMPANY ATLANTIC RICHFIELD COMPANY

WELL SORGUM GULCH AQUIFER NO. 1

FIELD

COUNTY RIO BLANCO STATE COLORADO

Location. API Serial No. 07174

Sec. 7 Twp. 3S Rge. 96W

Other Services:
FDC-GR
CNL-GR
BHC-GR TEMP.

Permanent Datum: GL ; Elev.: 6909
Log Measured From GL , 0 Ft. Above Perm. Datum
Drilling Measured From GL

Elev.: K.B.
D.F.
G.L. 6909

Date	7-5-74			
Run No.	ONE			
Depth—Driller	1338			
Depth—Logger	1339			
Btm. Log Interval	1333			
Top Log Interval	166			
Casing—Driller	13-3/8@ 166	@	@	@
Casing—Logger	166			
Bit Size	12-1/4			
Type Fluid in Hole	WATER			
Fluid Level	410			
Dens. | Visc.				
pH | Fluid Loss	ml	ml	ml	ml
Source of Sample				
R_m @ Meas. Temp.	@ °F	@ °F	@ °F	@ °F
R_{mf} @ Meas. Temp.	@ °F	@ °F	@ °F	@ °F
R_{mc} @ Meas. Temp.	@ °F	@ °F	@ °F	@ °F
Source: R_{mf} | R_{mc}				
R_m @ BHT	@ °F	@ °F	@ °F	@ °F
Time Since Circ.				
Max. Rec. Temp.	68 °F	°F	°F	°F
Equip. | Location	7674 VERNAL			
Recorded By	HAUGAARD			
Witnessed By	TATE			

CHANGES IN MUD TYPE OR ADDITIONAL SAMPLES

Date | Sample No.				
Depth - Driller				
Type Fluid in Hole				
Dens. | Visc.				
ph | Fluid Loss		ml		ml
Source of Sample				
R_m @ Meas. Temp.	@	°F	@	°F
R_{mf} @ Meas. Temp.	@	°F	@	°F
R_{mc} @ Meas. Temp.	@	°F	@	°F
Source: R_{mf} | R_{mc}				
R_m @ BHT	@	°F	@	°F
R_{mf} @ BHT	@	°F	@	°F
R_{mc} @ BHT	@	°F	@	°F

SCALE CHANGES

Type Log	Depth	Scale Up Hole	Scale Down Hole

EQUIPMENT DATA

Run No.	ONE			
Panel No.	D-322			
Cart. No.	B-234			
Sonde No.	DB-169			
Mem. Panel No.	----			
G.R. Cart No.	----			
G.R. Panel No.	----			
TTR No.	----			
Cent. Device	----			
Stand off - Inches	1-1/2"			
Time Const. - Sec.	----			
Speed - F.P.M.	80			

REMARKS

Service Order No. - SO #07174

☒ Surface determined sonde errors used for 6FF40.

☐ 6FF40 sonde error corrected for inch

borehole signal at R_m =

☐ 6FF40 zero set in hole at depth of feet.

CALIBRATION DATA

CALIBRATION.	BACKGND. CPS.	SOURCE CPS	GALV. INCR. DIVISION	SENS. TAP (FOR CAL.)	SENS. TAP (RECORD)	TIME CONST
GAMMA RAY.						

CALIBRATION:	BACKGND. CPS.	SOURCE CPS.	GALV. INCR. DIVISION	SENS. TAP (FOR CAL.)	SENS. TAP (RECORD)	TIME CONST.	
GAMMA RAY:							

All interpretations are opinions based on inferences from electrical or other measurements and we cannot, and do not guarantee the accuracy or correctness of any interpretations, and we shall not, except in the case of gross or willful negligence on our part, be liable or responsible for any loss, costs, damages or expenses incurred or sustained by anyone resulting from any interpretation made by any of our officers, agents or employees. These interpretations are also subject to Clause 7 of our General Terms and Conditions as set out in our current Price Schedule.

SPONTANEOUS-POTENTIAL

MILLIVOLTS

— |15 MV| +

CONDUCTIVITY

MILLIMHOS/M = $\frac{1000}{\text{OHMS. M}^2\text{/M}}$

DEEP INDUCTION LOG

400 200 0

RESISTIVITY

OHMS. M^2/M

DEEP INDUCTION LOG

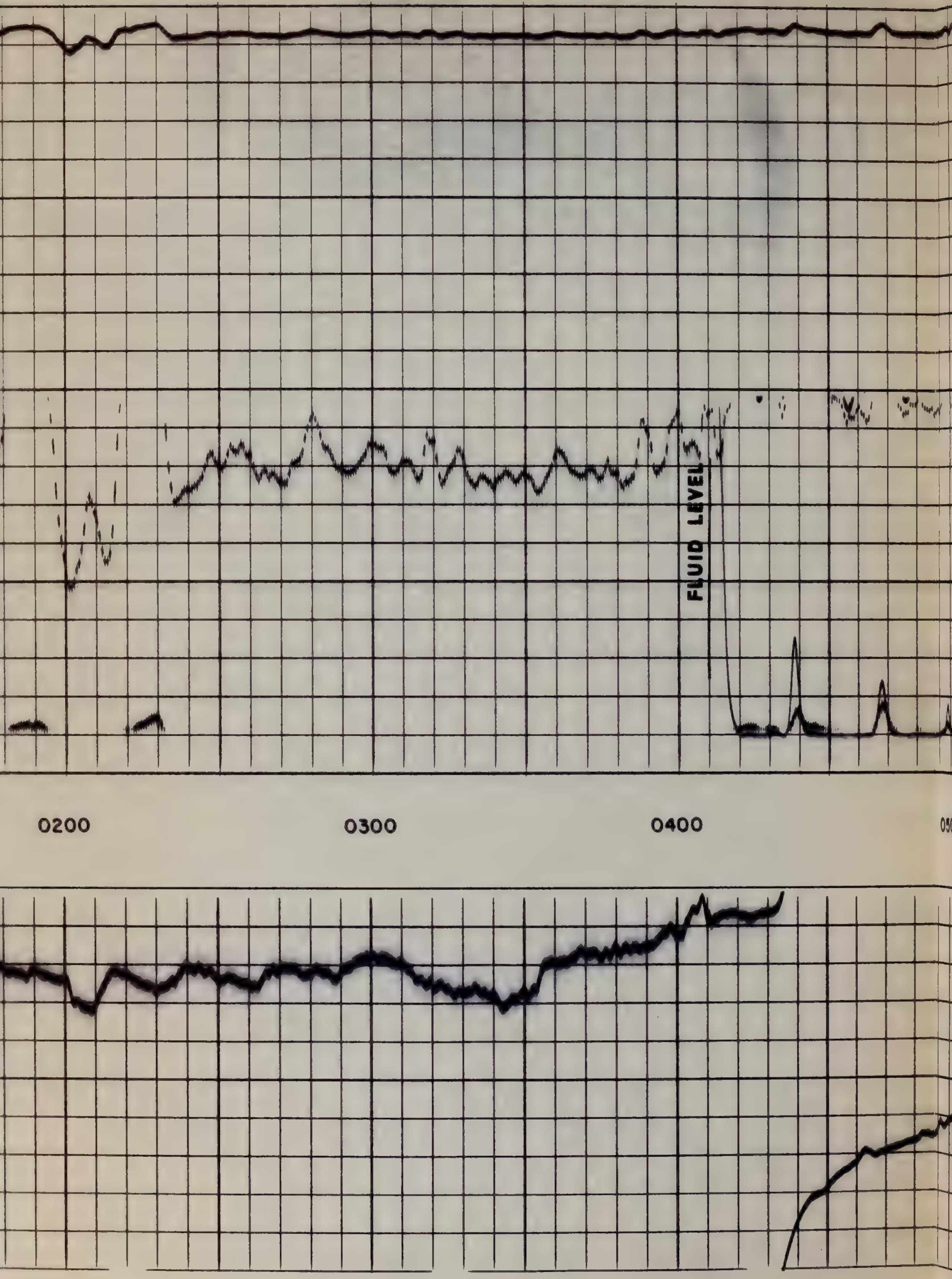
0 100

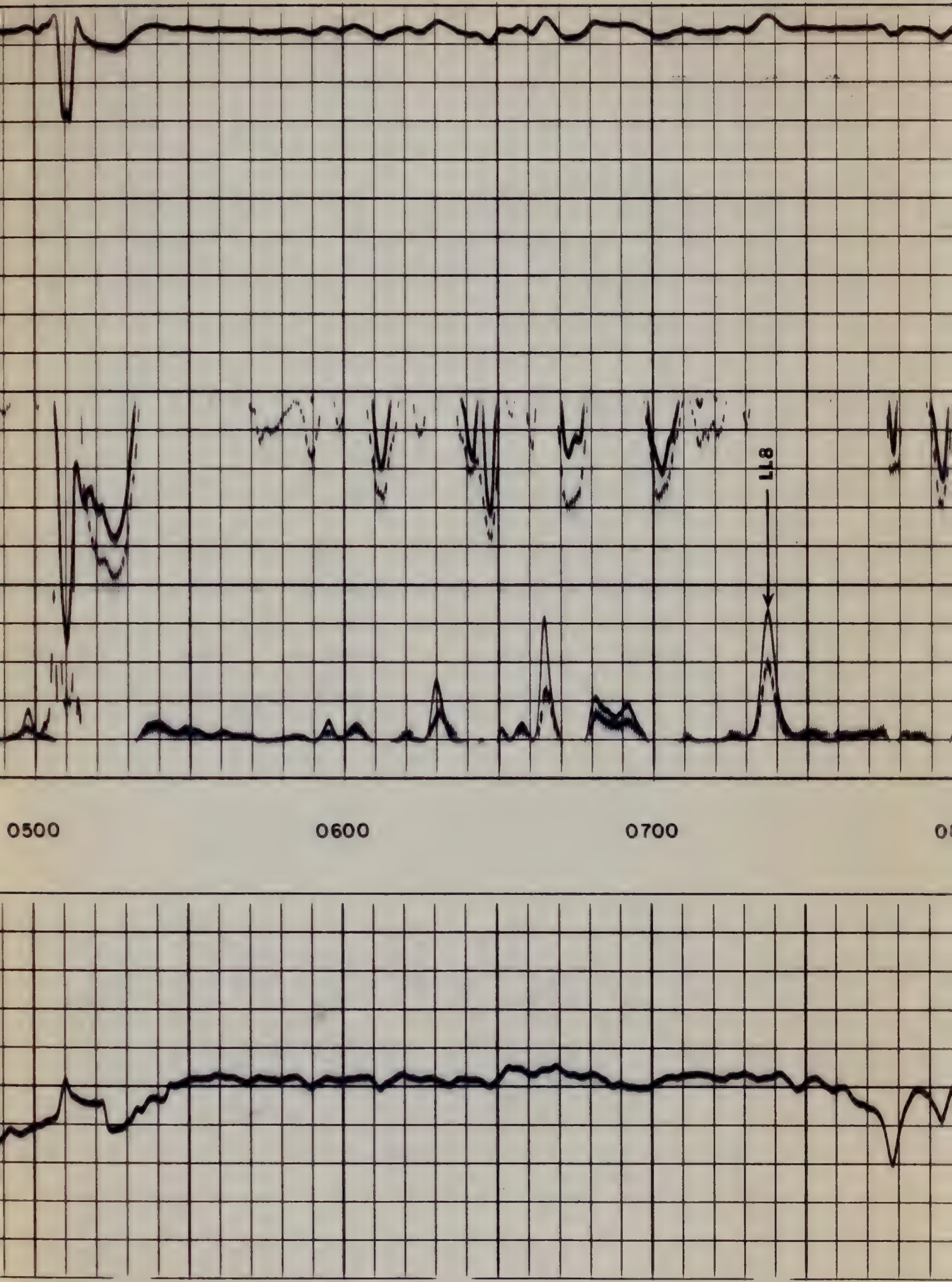
0 1000

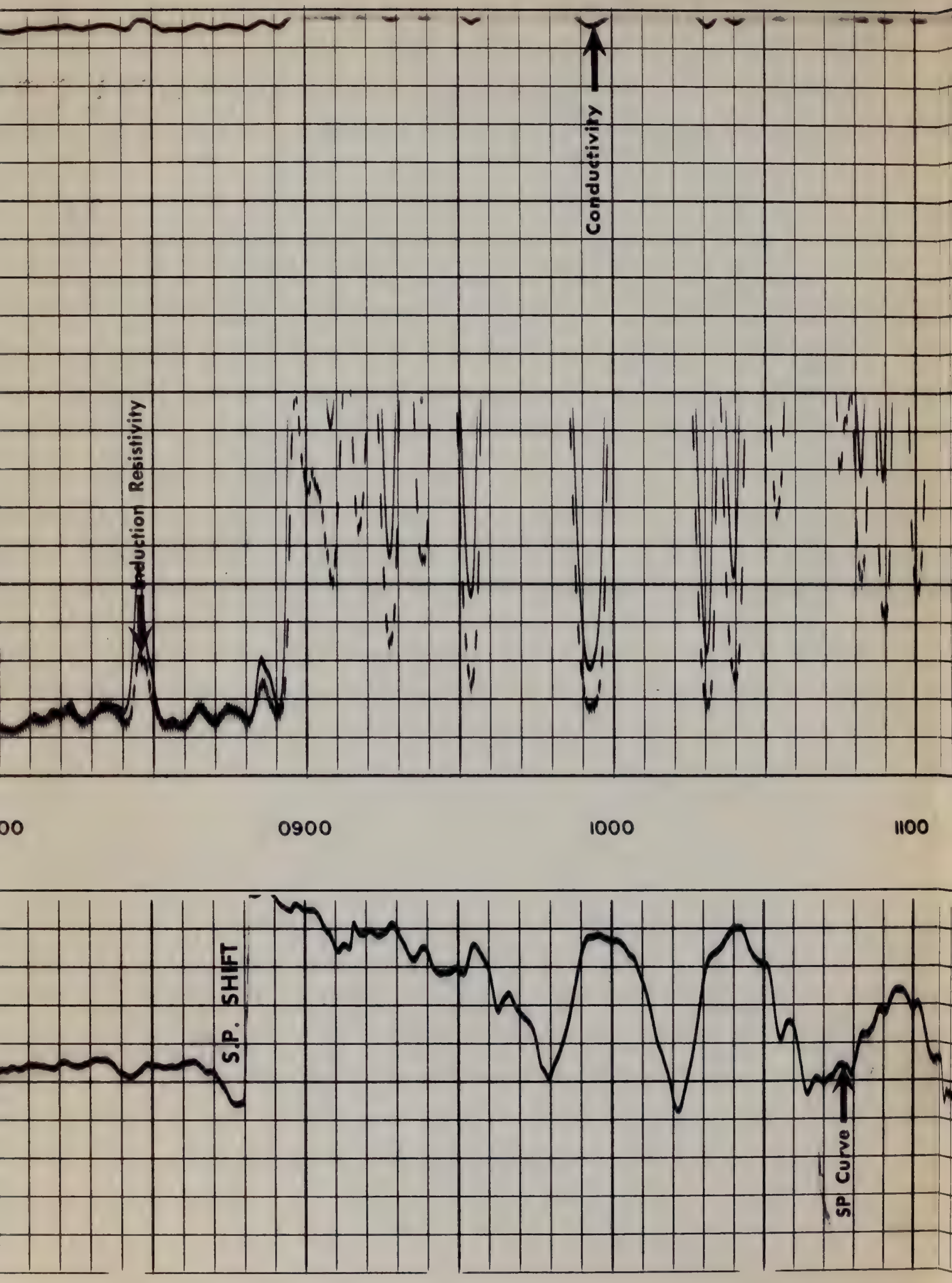
AVERAGED LATEROLOG - 8

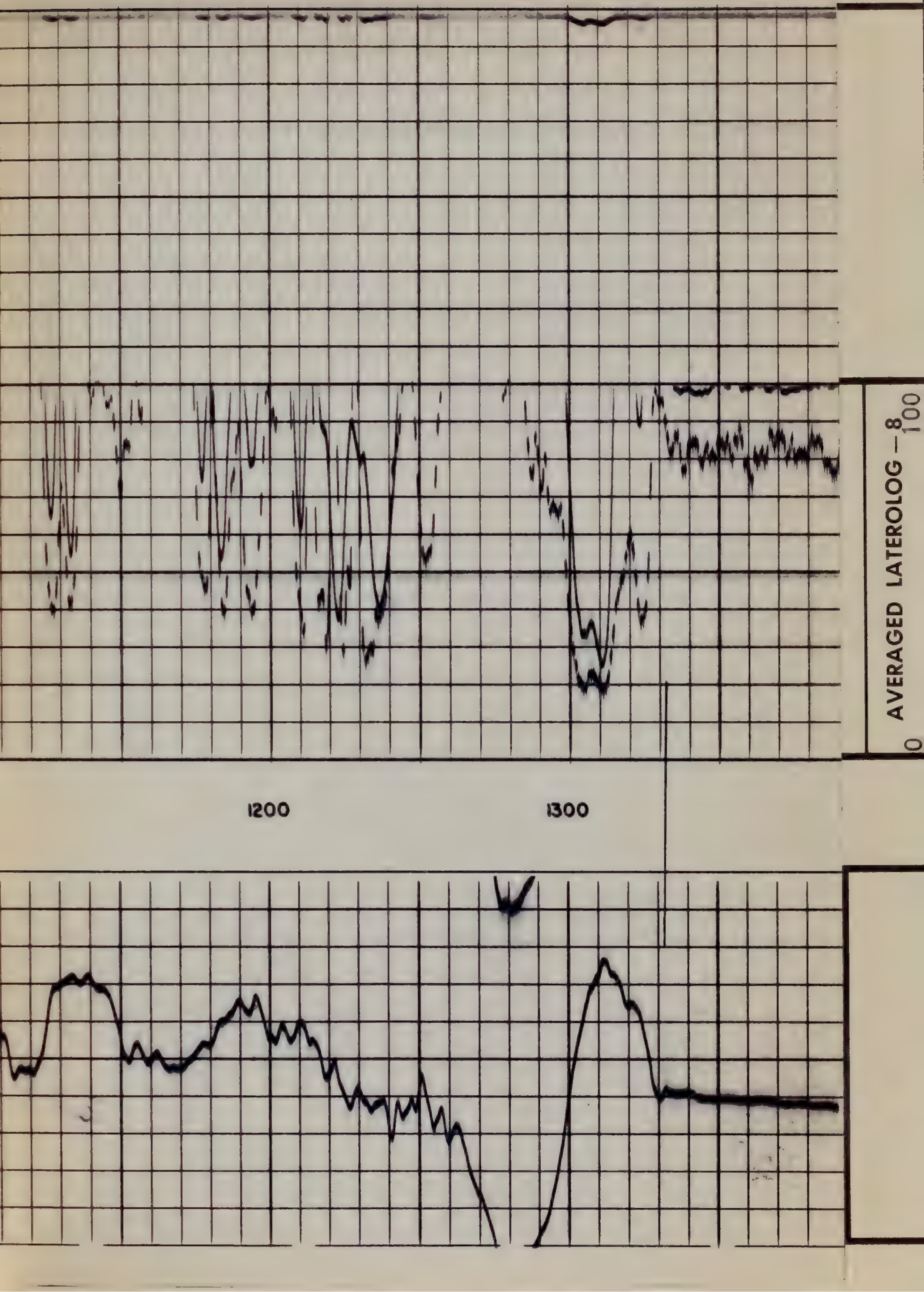
0 100

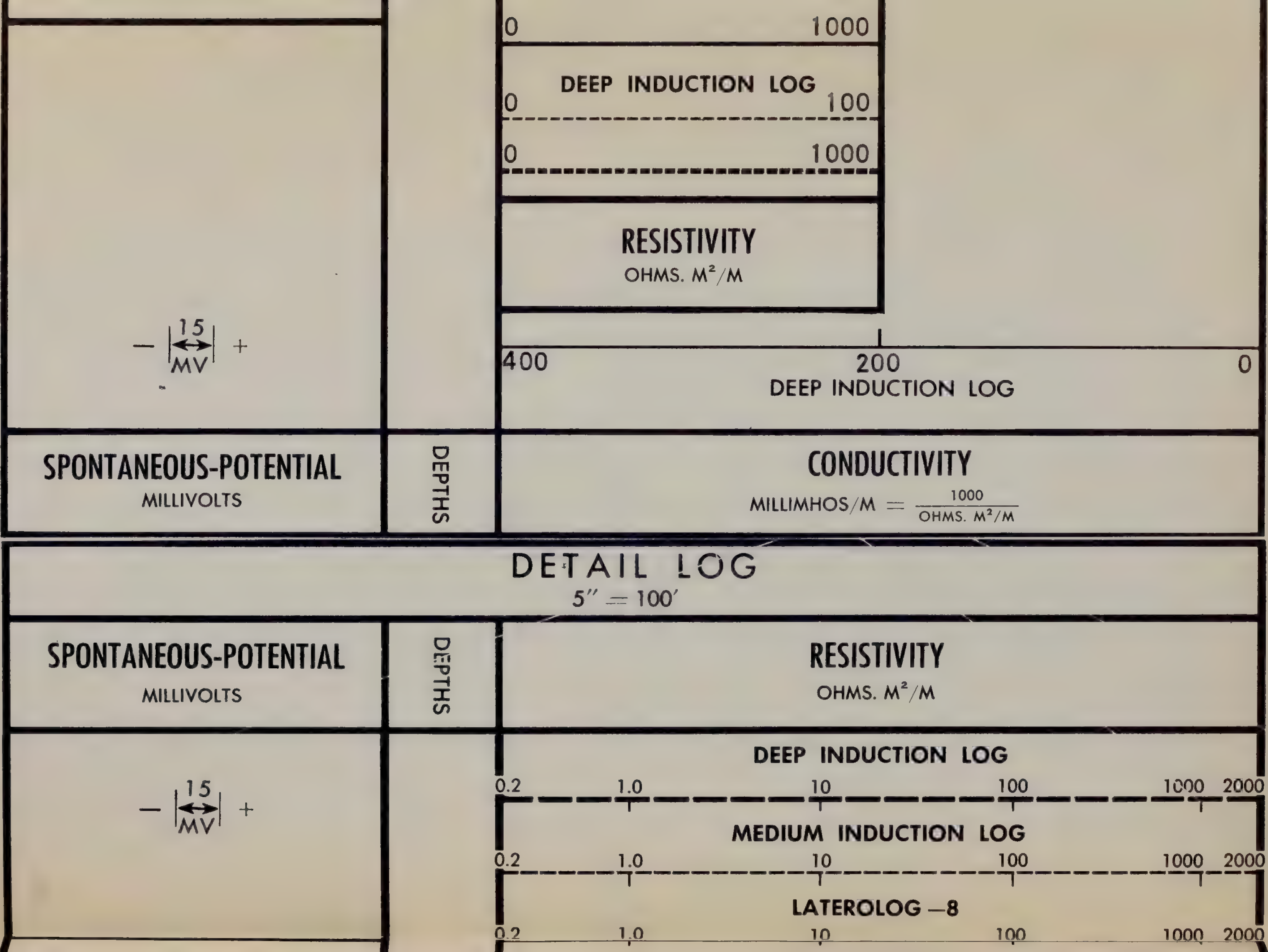
0 1000

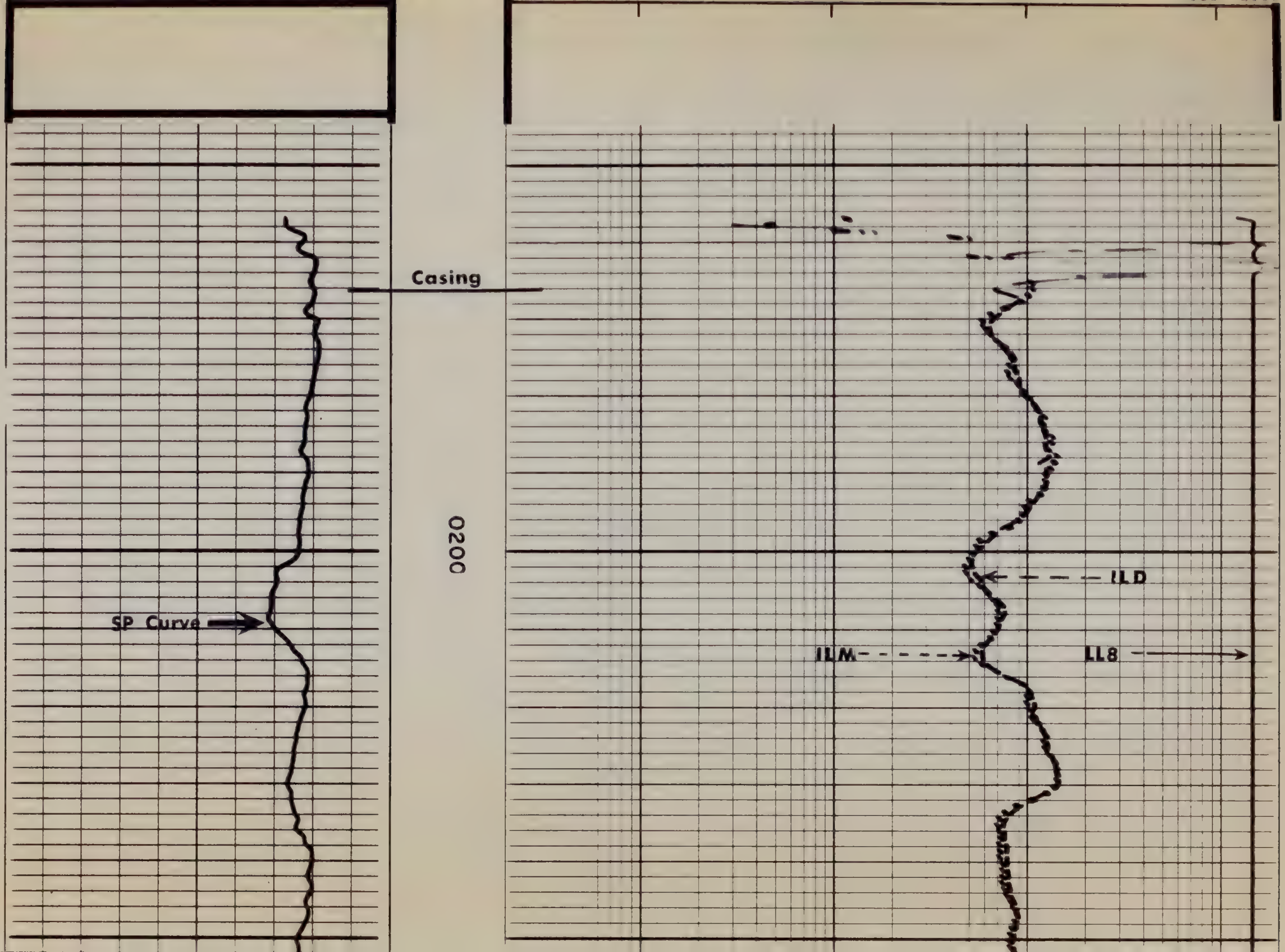

FLUID LEVEL
0200
0300
0400
050

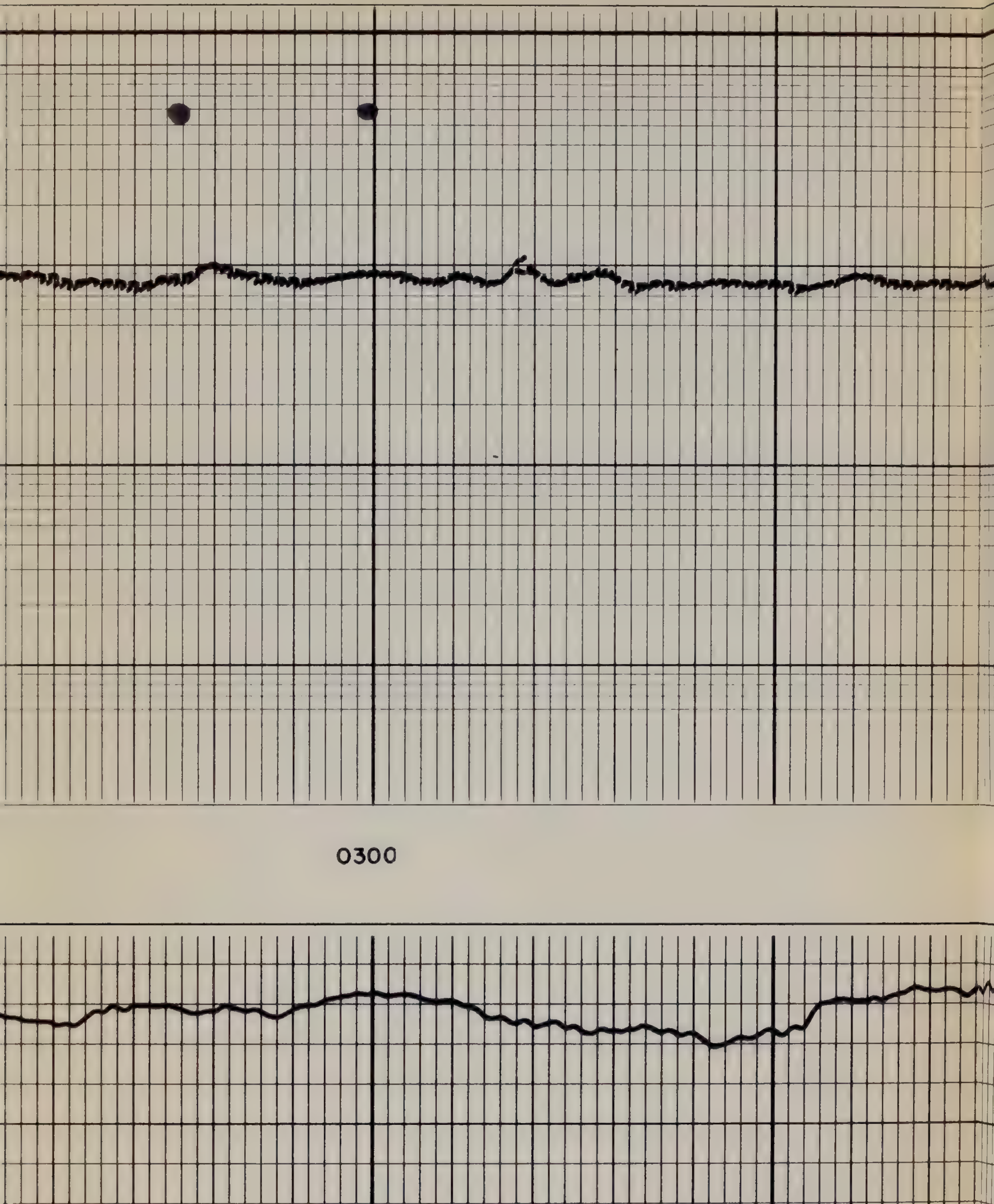

118
0500
0600
0700
0

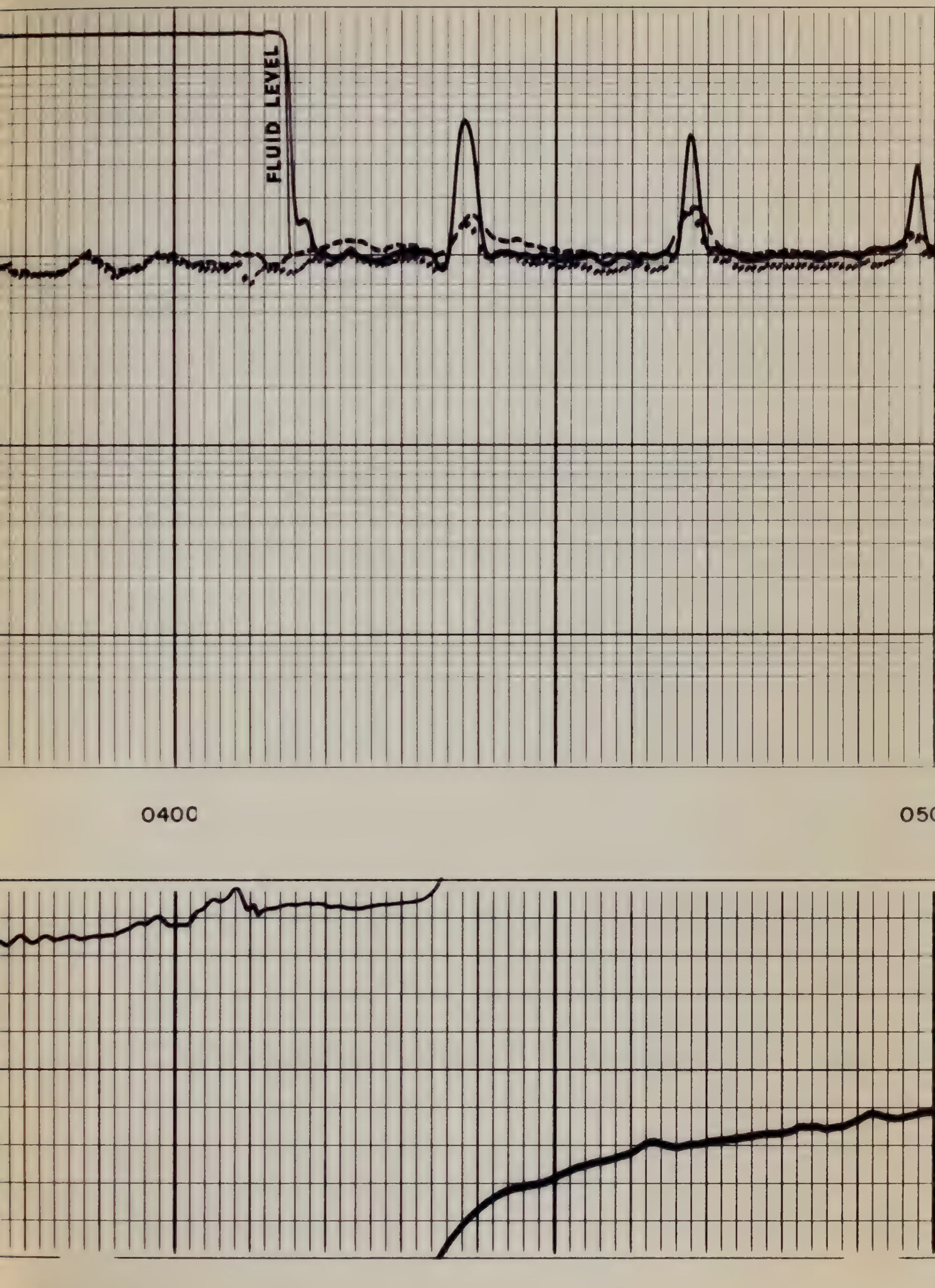

Conductivity
Induction Resistivity
00
0900
1000
1100
S.P. SHIFT
SP Curve

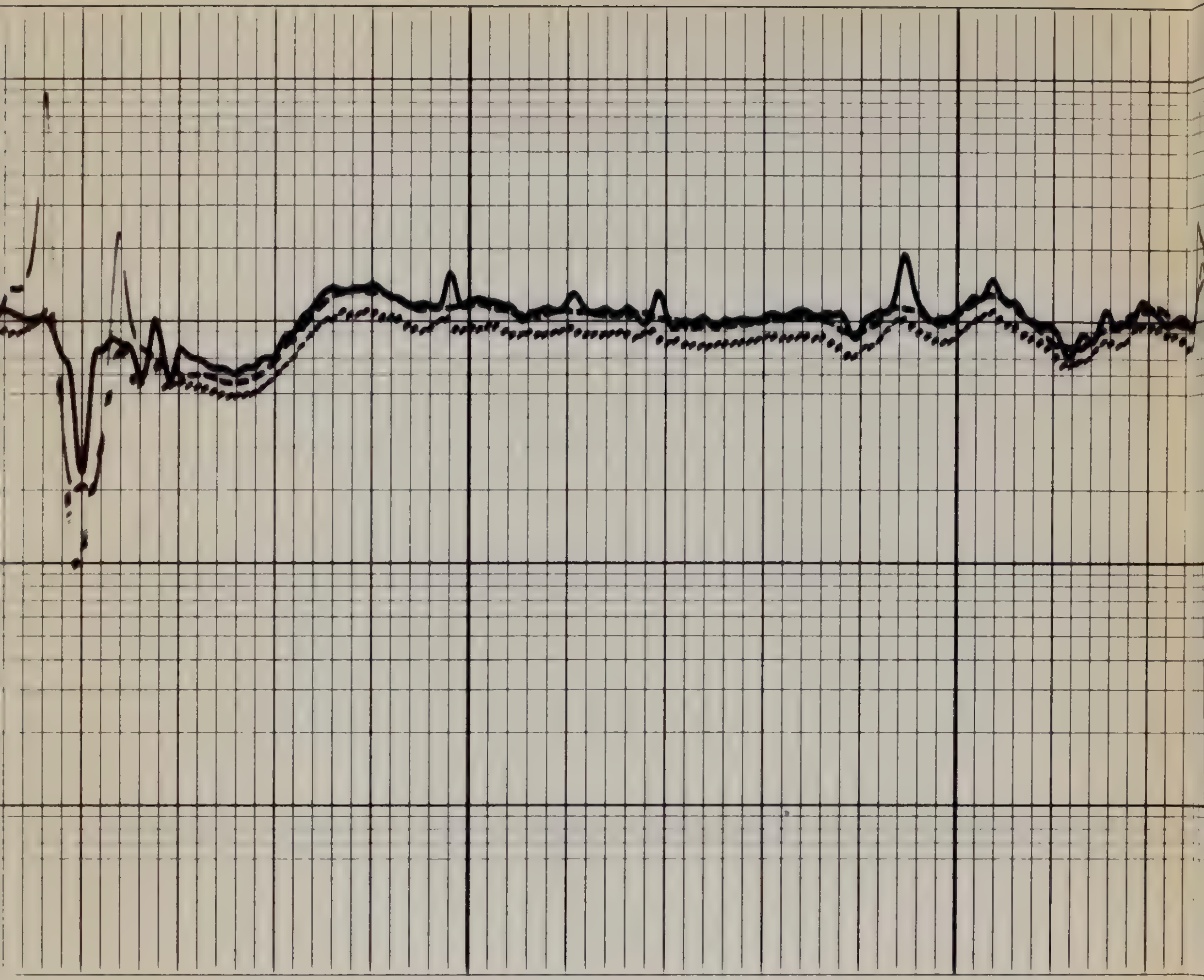

AVERAGED LATEROLOG — 8
0
100
1200
1300


0 1000
DEEP INDUCTION LOG
0 100
0 1000
RESISTIVITY
OHMS. M²/M
— |15 MV| +
400 200 0
DEEP INDUCTION LOG
SPONTANEOUS-POTENTIAL
MILLIVOLTS
DEPTHS
CONDUCTIVITY
MILLIMHOS/M = 1000 / OHMS. M²/M
DETAIL LOG
5″ = 100′
SPONTANEOUS-POTENTIAL
MILLIVOLTS
DEPTHS
RESISTIVITY
OHMS. M²/M
— |15 MV| +
DEEP INDUCTION LOG
0.2 1.0 10 100 1000 2000
MEDIUM INDUCTION LOG
0.2 1.0 10 100 1000 2000
LATEROLOG —8
0.2 1.0 10 100 1000 2000


Casing
0200
ILD
SP Curve
ILM
LL8

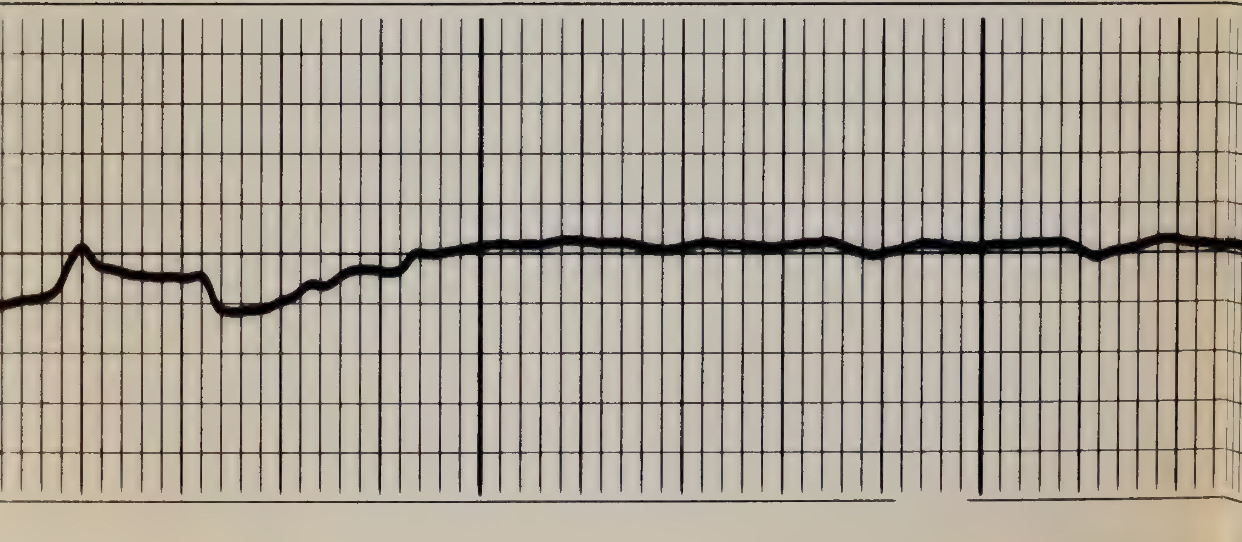

0300

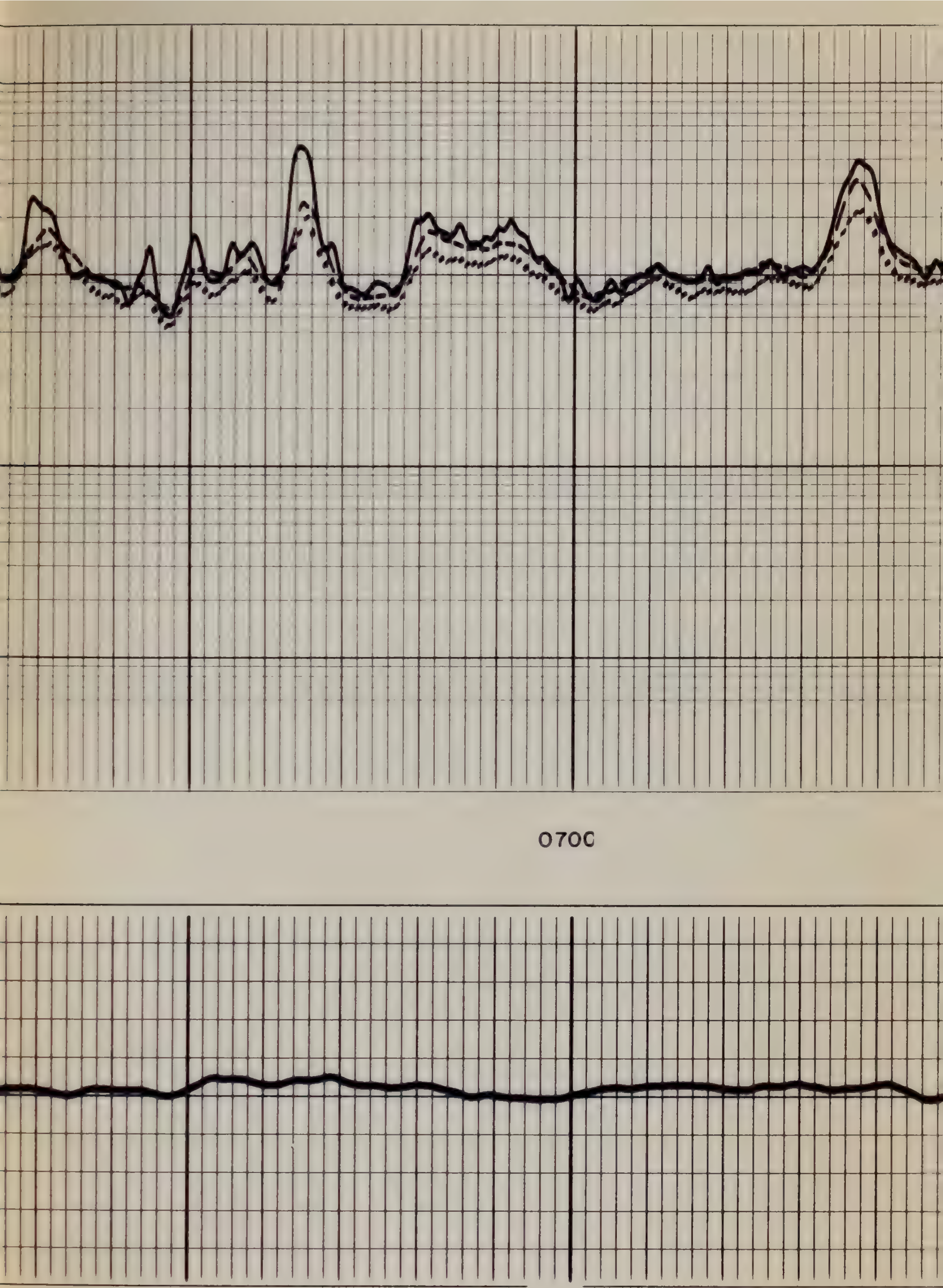

FLUID LEVEL
0400
050

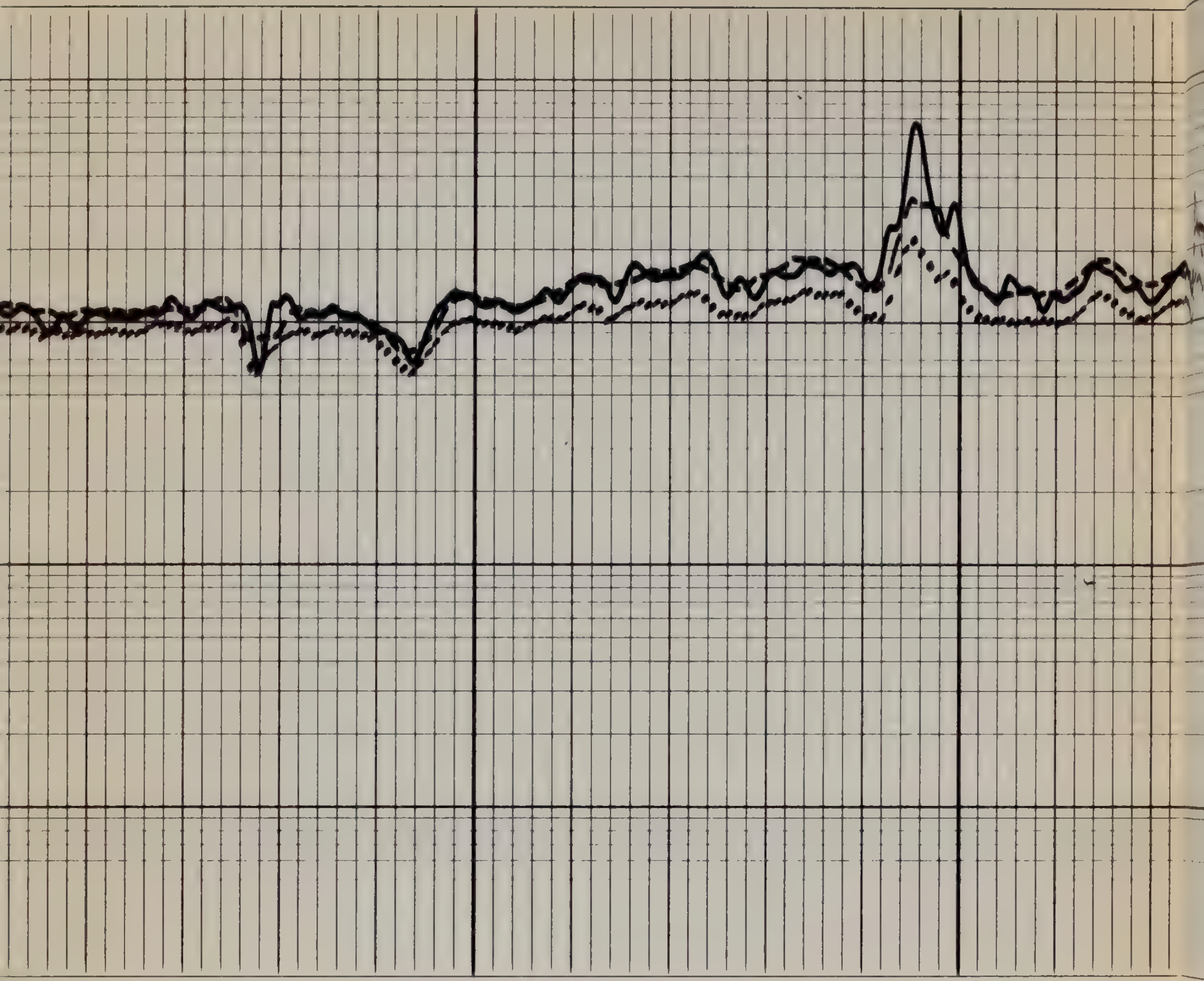


C

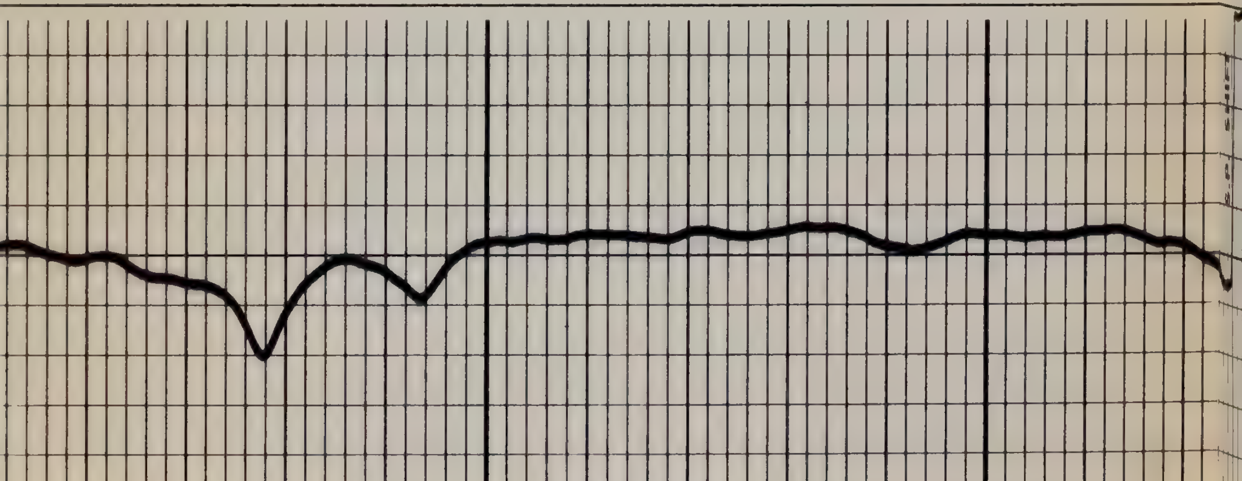
O6OC

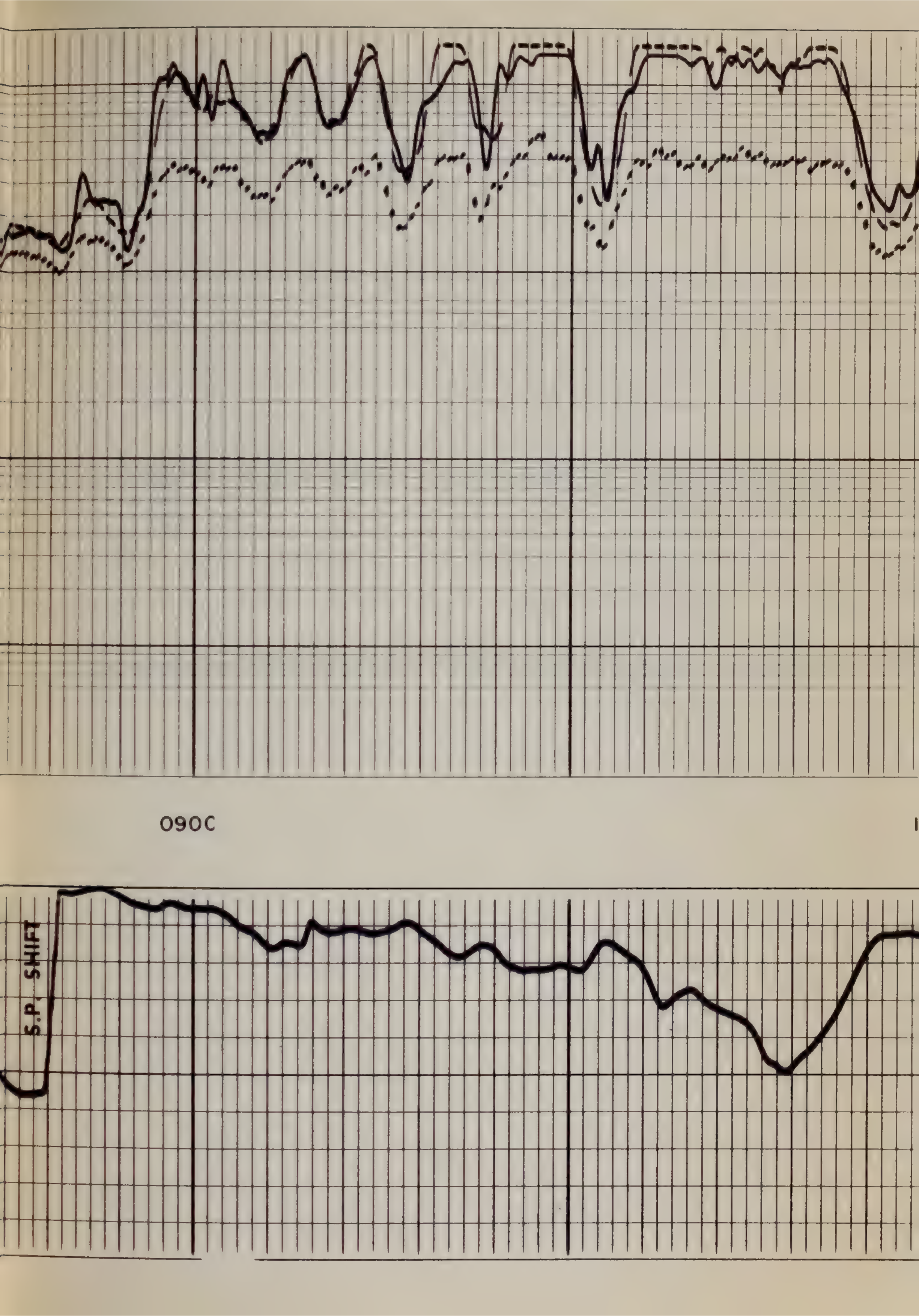


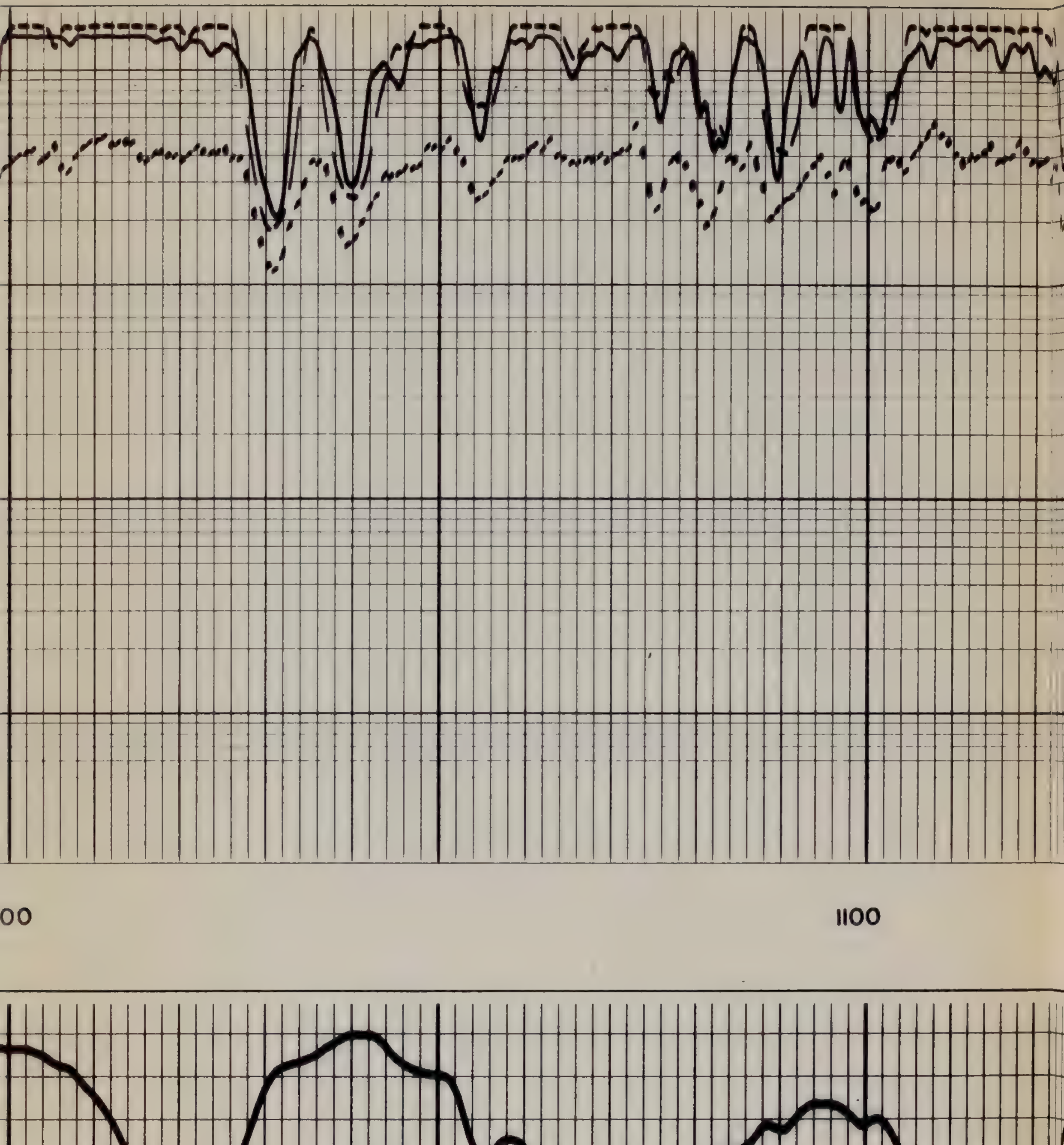

0700

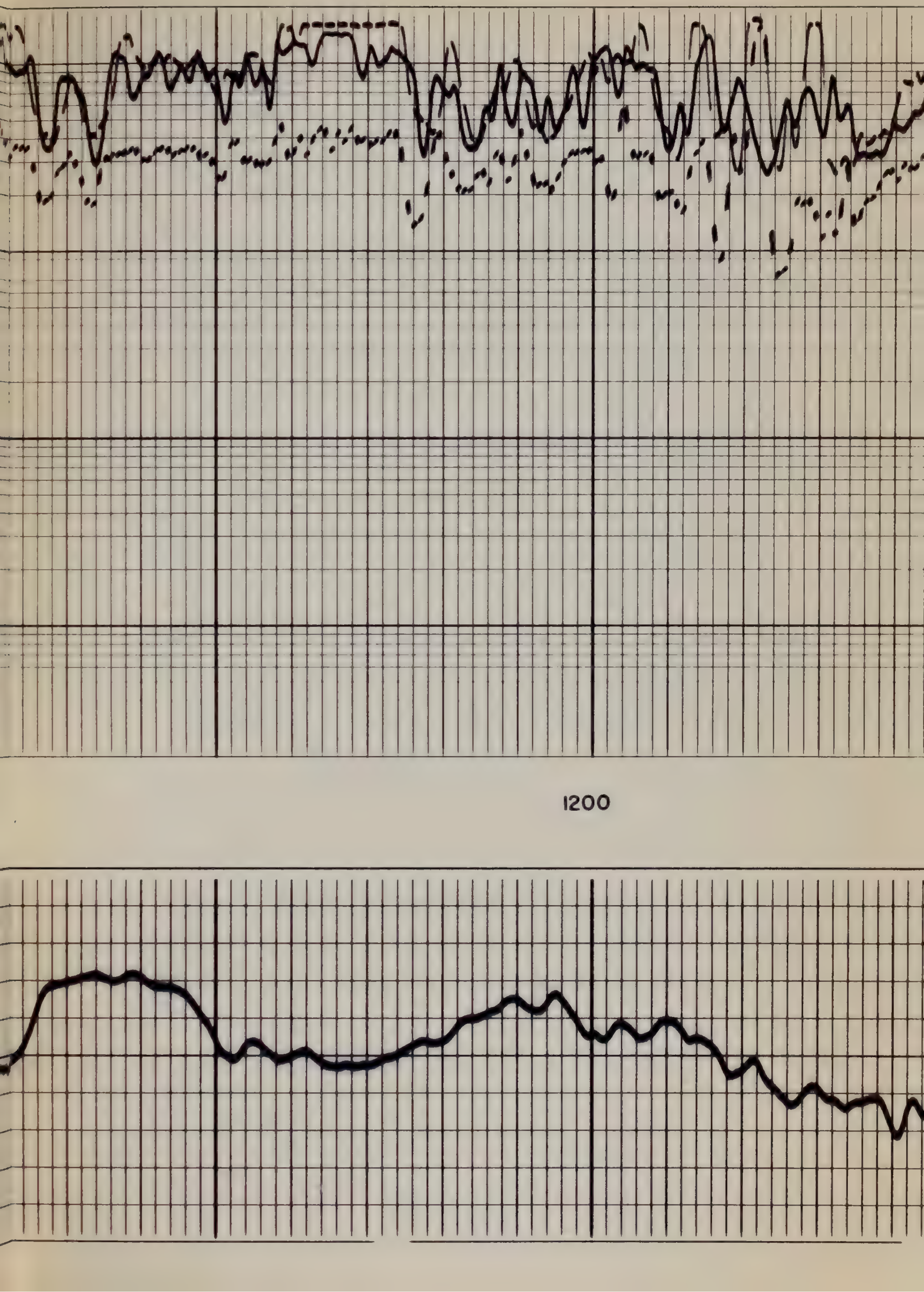


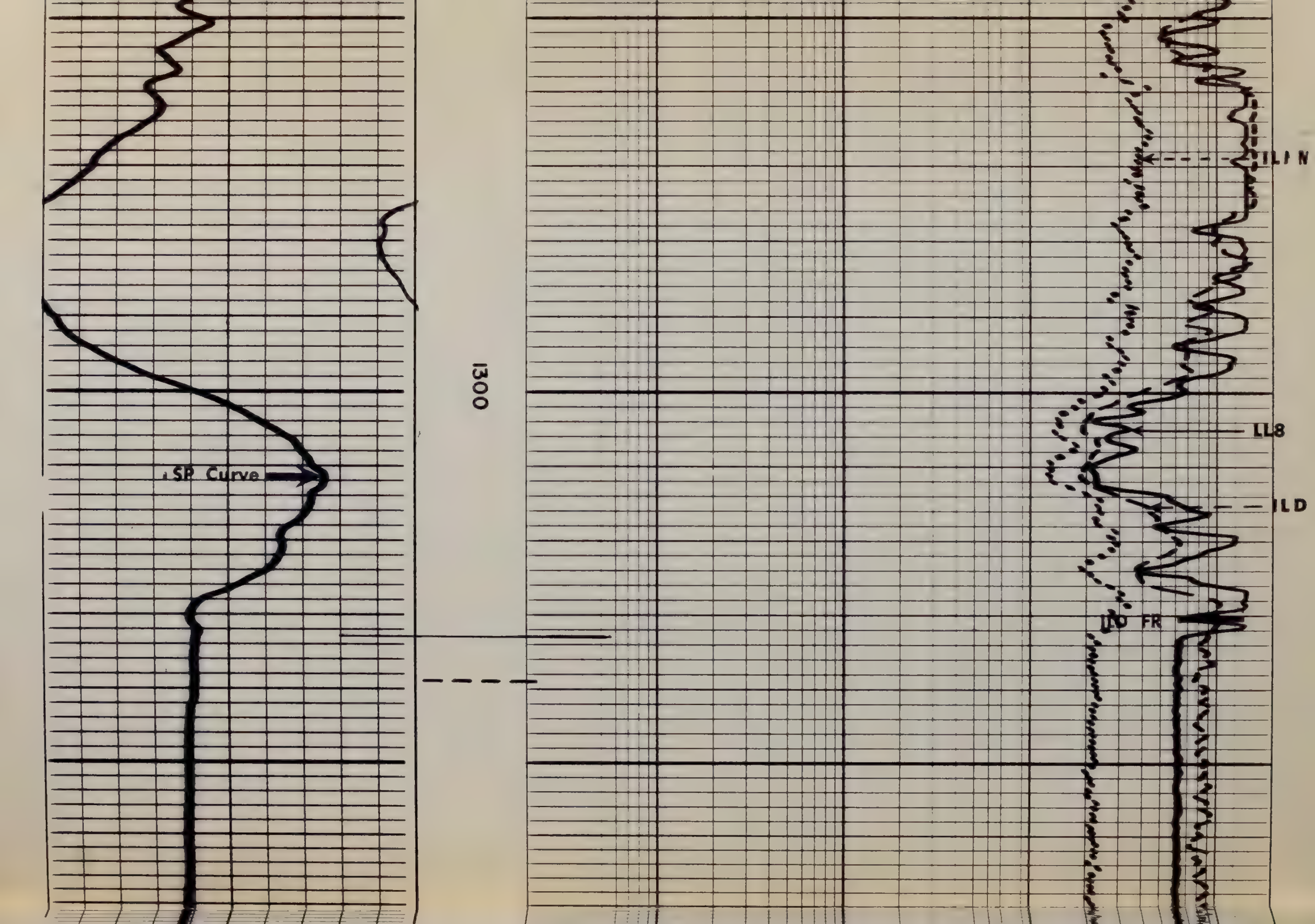
080C

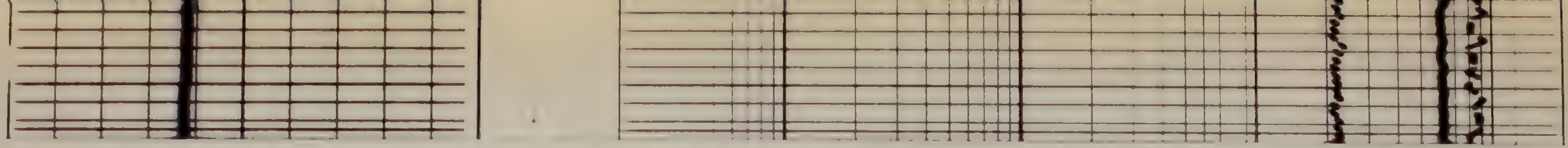


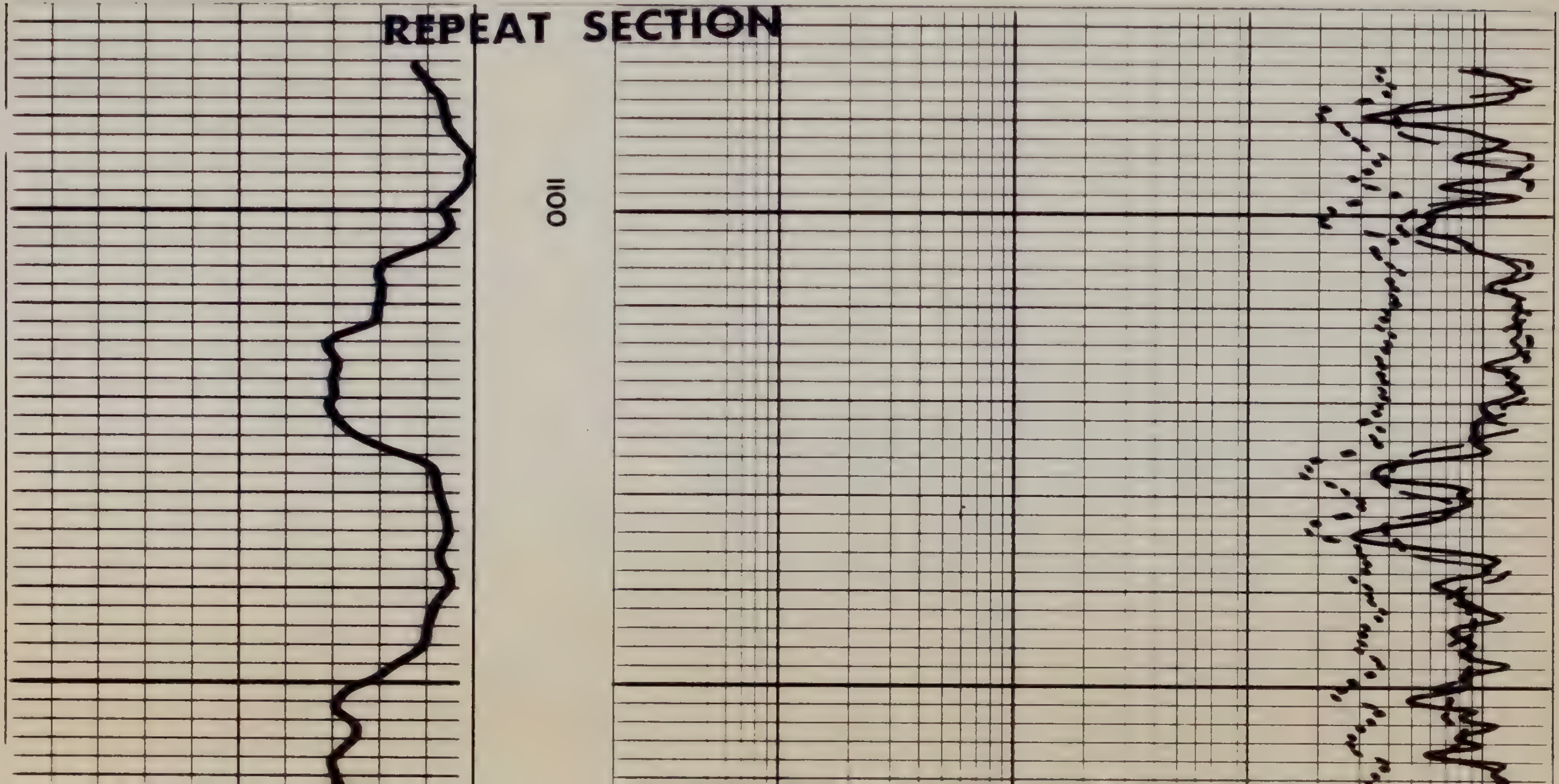

0900
S.P. SHIFT

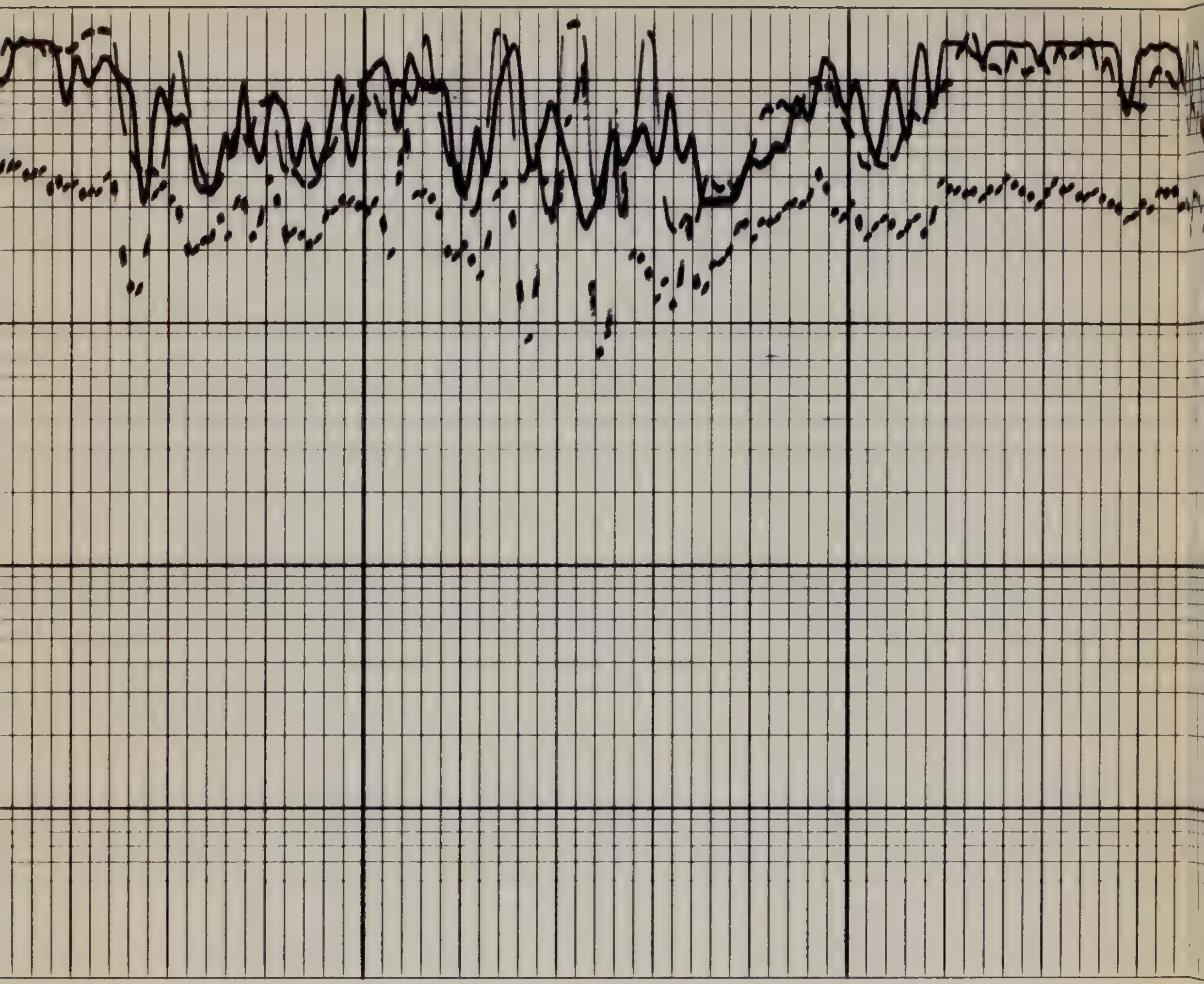

00
1100

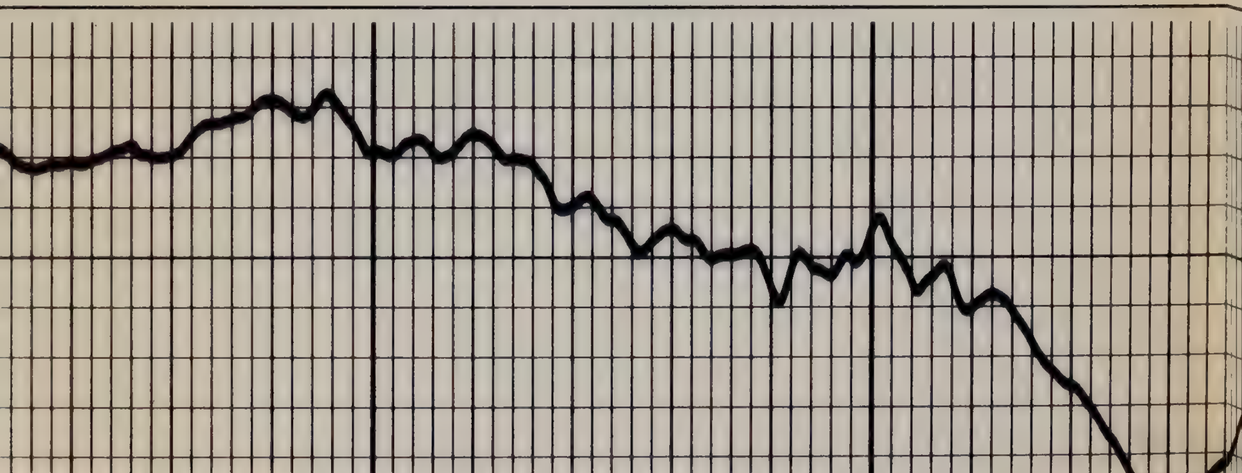

1200

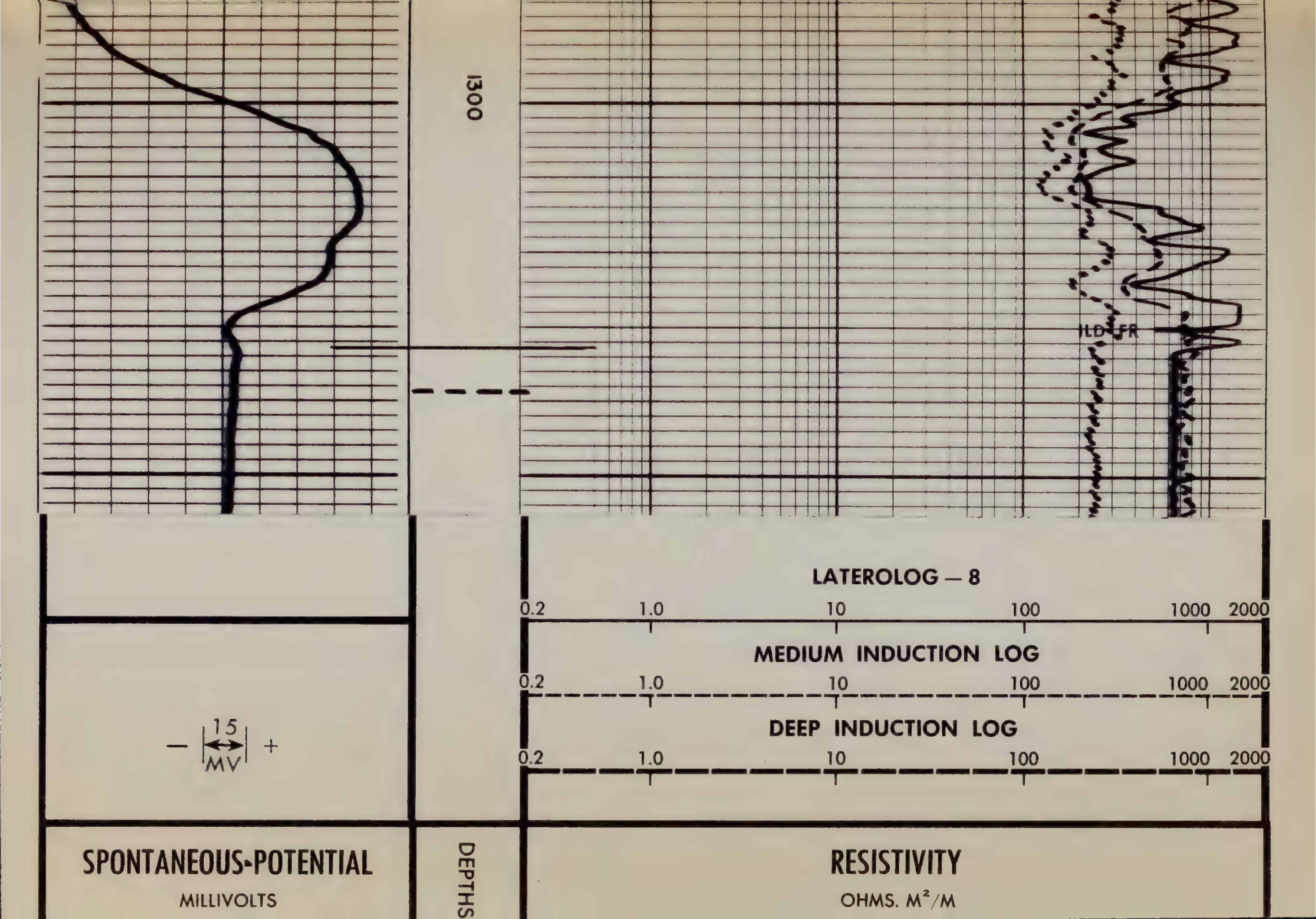

SP Curve
1300
ILM
LL8
ILD
TD FR




REPEAT SECTION
1100




1200

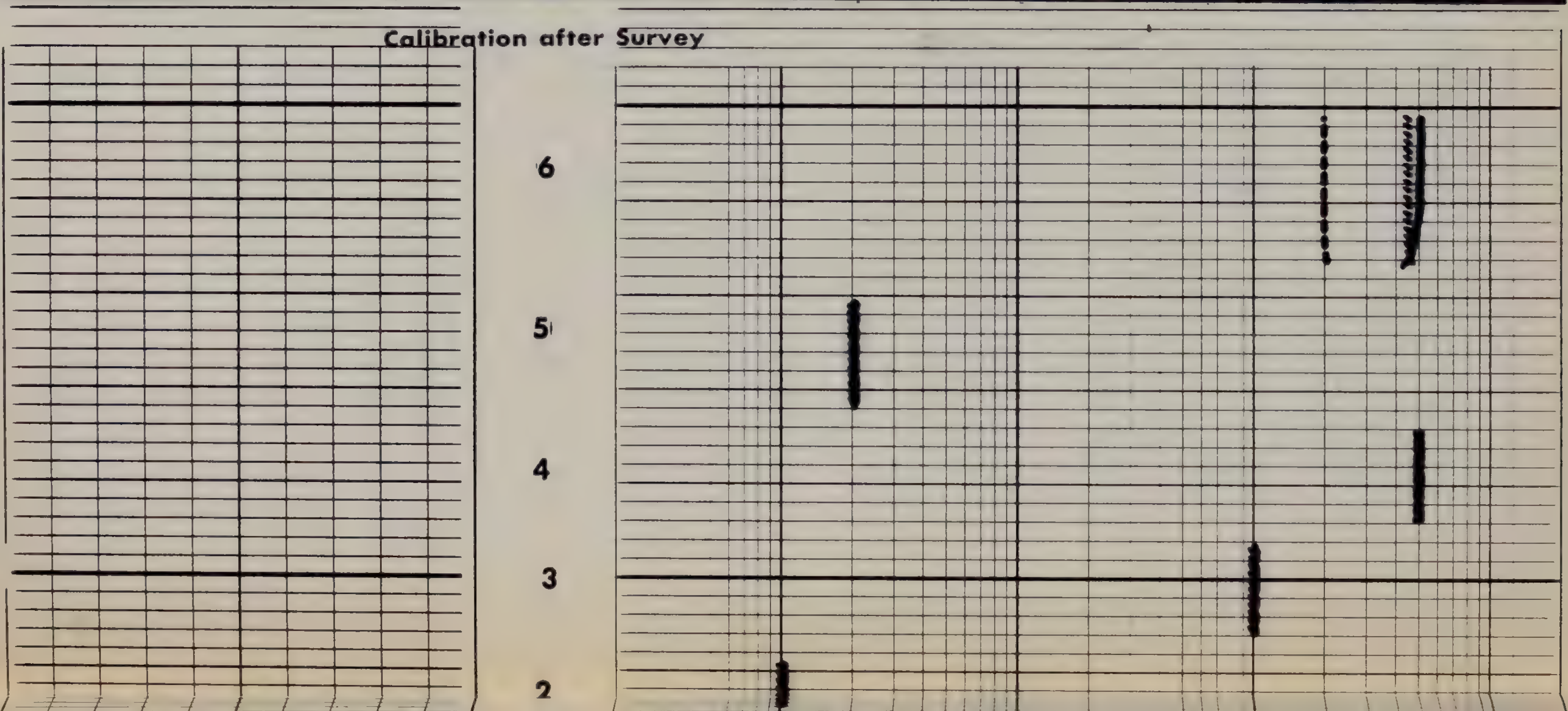

1300
ILD-FR
LATEROLOG — 8
0.2
1.0
10
100
1000
2000
MEDIUM INDUCTION LOG
0.2
1.0
10
100
1000
2000
DEEP INDUCTION LOG
0.2
1.0
10
100
1000
2000
— 15 MV +
SPONTANEOUS-POTENTIAL
MILLIVOLTS
DEPTHS
RESISTIVITY
OHMS. M²/M

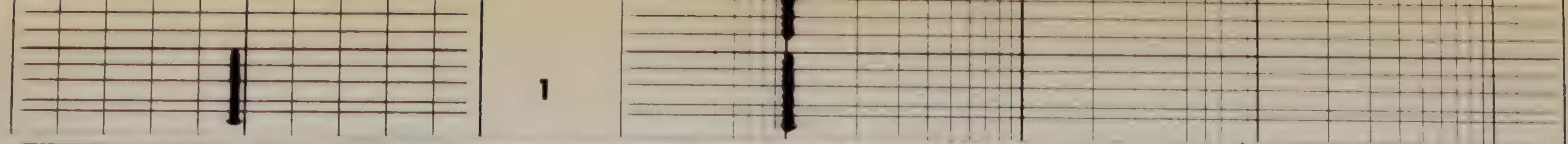
COMPANY ATLANTIC RICHFIELD COMPANY
WELL SORGUM GULCH AQUIFER NO. 1
FIELD
COUNTY RIO BLANCO STATE COLORADO

SCHL. FR 1333
SCHL. TD 1339
DRLR TD 1338
Elev:
KB ----
DF ----
GL 6909

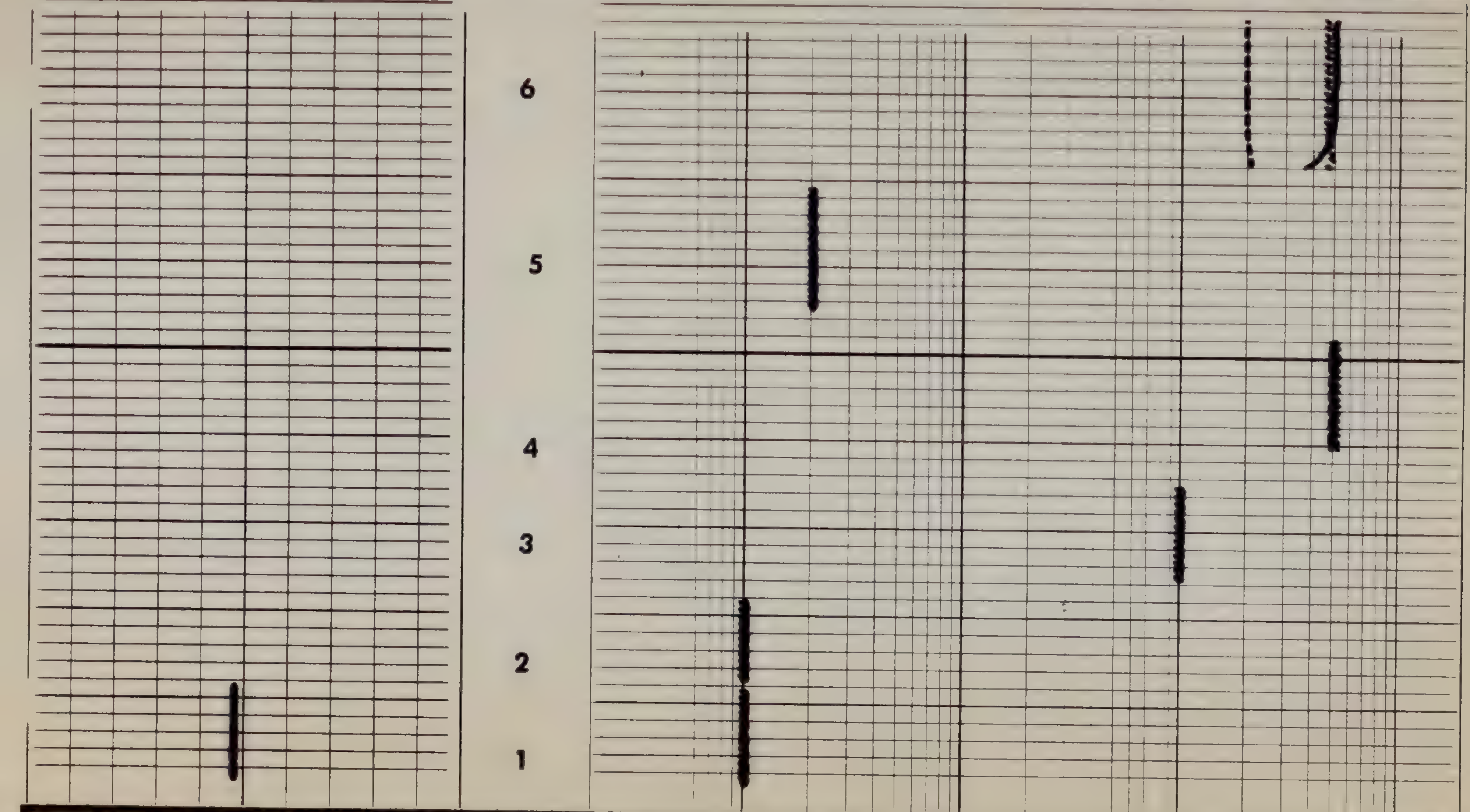
CALIBRATION RECORD

▼


Calibration after Survey



Calibration before Survey



DUAL INDUCTION CALIBRATION FILM CODING

1. MECHANICAL ZERO

2. 1 OHM-M
3. 100 OHM-M
4. ELECTRICAL ZERO (500 OHM-M)
5. 2 OHM-M
6. SONDE ERRORS (+2 MMHO)
7. ZERO SIGNAL IN AIR
8. ILd TEST LOOP (2 OHM SIGNAL)
9. ILm TEST LOOP (2 OHM SIGNAL)
10. Rxo/Rt UNITY
11. Rxo/Rt CALIBRATE

CALIBRATION RECORD

COMPANY ATLANTIC RICHFIELD COMPANY

WELL SORGUM GULCH AQUIFER NO. 1

FIELD

COUNTY RIO BLANCO STATE COLORADO

SCHL. FR 1333
SCHL. TD 1339
DRLR TD 1338
Elev:
KB ----
DF ----
GL 6909

SWS–1918-B

COUNTY RIO BLANCO

Schlumberger

COMPENSATED FORMATION DENSITY LOG

Gamma-Gamma

COUNTY RIO BLANCO
FIELD or LOCATION
WELL SORGUM GULCH AQUIFER NO. 1
COMPANY ATLANTIC RICHFIELD

COMPANY ATLANTIC RICHFIELD COMPANY

WELL SORGUM GULCH AQUIFER NO. 1

FIELD

COUNTY RIO BLANCO STATE COLORADO

Location: API Serial No. 07174

Sec. 7 Twp. 3S Rge. 96W

Other Services:
DIL TEMP.
CNL-GR
BHC-GR

Permanent Datum: GL ; Elev.: 6909
Log Measured From GL , 0 Ft. Above Perm. Datum
Drilling Measured From GL

Elev.: K.B. ----
D.F. ----
G.L. 6909

Date	7-5-74			
Run No.	ONE			
Depth—Driller	1338			
Depth—Logger	1339			
Btm. Log Interval	1337			
Top Log Interval	162			
Casing—Driller	13-3/8 @166	@	@	@
Casing—Logger	162			
Bit Size	12-1/4			
Type Fluid in Hole	WATER			
Fluid Level	410			
Dens. | Visc.				
pH | Fluid Los	ml	ml	ml	ml
Source of Sample				
Rm @ Meas. Temp.	@ °F	@ °F	@ °F	@ °F
Rmf @ Meas. Temp.	@ °F	@ °F	@ °F	@ °F
Rmc @ Meas. Temp.	@ °F	@ °F	@ °F	@ °F
Source: Rmf | Rmc				
Rm @ BHT	@ °F	@ °F	@ °F	@ °F
Time Since Circ.				
Max. Rec. Temp.	68 °F	°F	°F	°F
Equip. | Location	7674 VERNAL			
Recorded By	HAUGAARD			
Witnessed By	TATE			

CHANGES IN MUD TYPE OR ADDITIONAL SAMPLES

Date	Sample No.				
Depth - Driller					
Type Fluid					
Source of Sample					
R_m @ Meas. Temp.		@	°F	@	°F
R_{mf} @ Meas. Temp.		@	°F	@	°F
R_{mc} @ Meas. Temp.		@	°F	@	°F
R_m @ BHT		@	°F	@	°F
Dens.	Visc.				
ph	Fluid Loss		ml		ml
% Water by Vol.					
% Oil by Vol.					
% Solids by Vol.					
Solids Av. Sp. Gr.					

SCALE CHANGES

Type Log	Depth	Scale Up Hole	Scale Down Hole

LOGGING DATA

		FDC Selectors			
Liquid Density	Grain Density	Hole Fluid	Porosity Scale	From	To
1.00	2.65	LIQUID	30/TK	TD	CSG

EQUIPMENT DATA

Run No.	ONE			
Panel No.	EA-355			
Cart No.	EA-263			
Skid No.	D-1095			
Sonde No.	E-235			
Source	2940			
Calibrator	545			
GR Cart.	J-98			
TTR	----			
Mem Panel	A-173			

REMARKS

Service Order No. - SO #07174

BIT SIZE/CASING DATA

Bit	From	To	Csg. Size	Csg. Wt.	From	To
12-1/4	1338	166	13-3/4		166	SURF.

CALIBRATION DATA

CALIBRATION DATA

Run No.	Gamma Ray			FDC — Before Log — ACPS		FDC — After Log — ACPS	
	API Scale	Background CPS	Total CPS	P_1	P_2	P_1	P_2
1	0-200	100	500	416	688	416	688
2							
3							
4							

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CALIPER

HOLE DIAM. IN INCHES

8 18

DEPTHS

RATIO

5.0 2.5 0

—.25 0 +.25

CORRECTION

GRAMS/CC.

GAMMA RAY

API UNITS

0 150

150 300

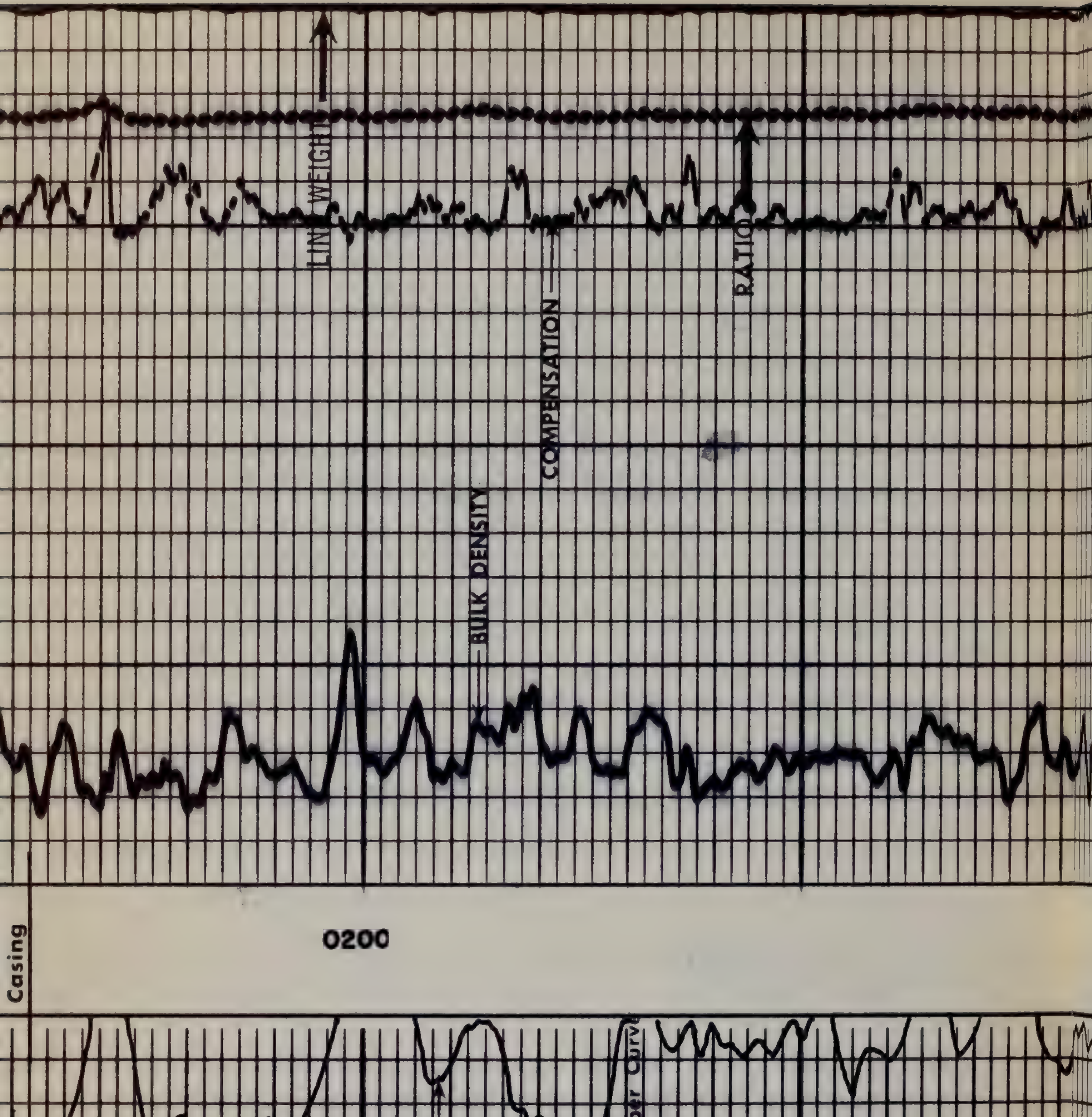
BULK DENSITY

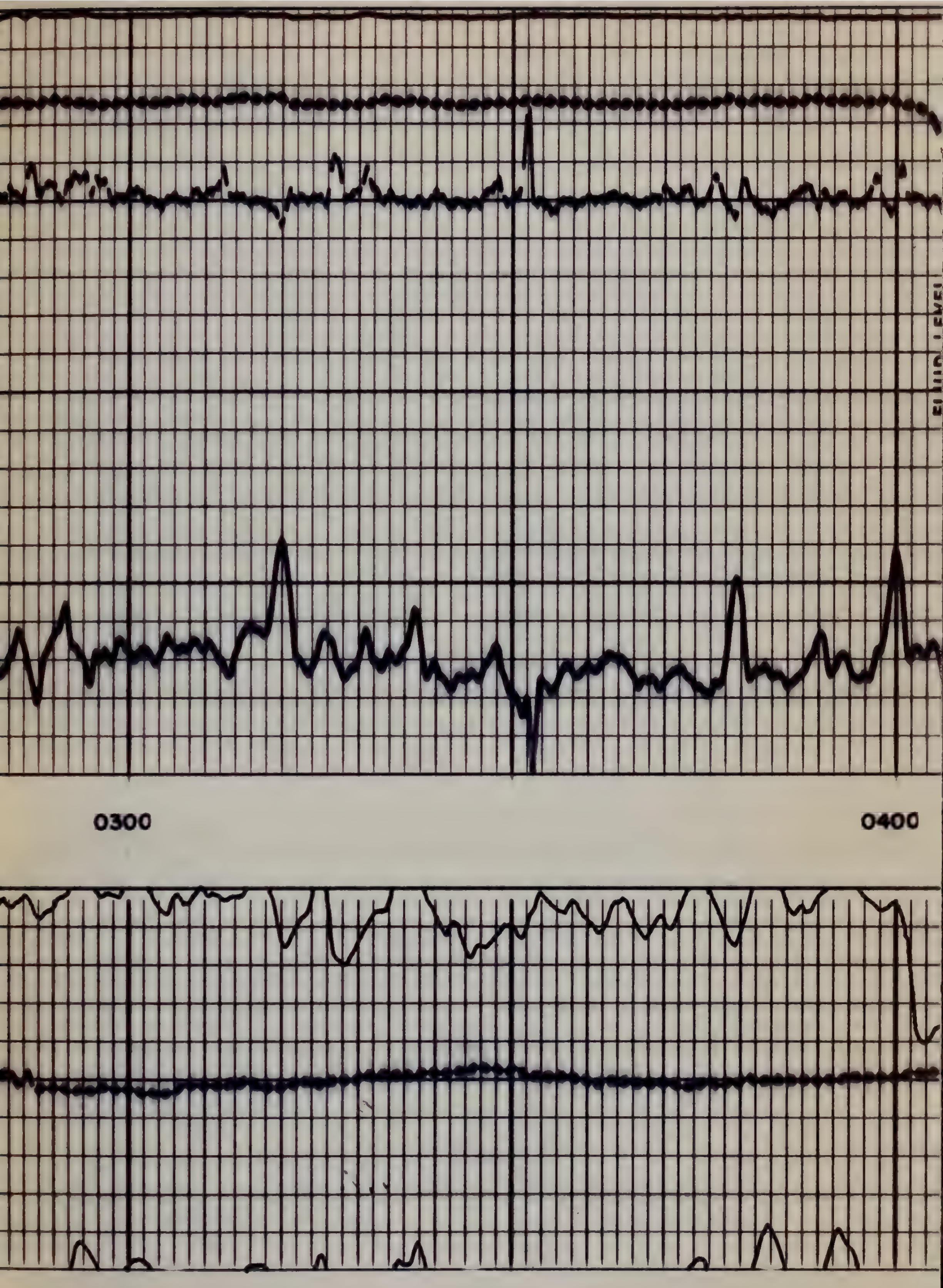
GRAMS CC.

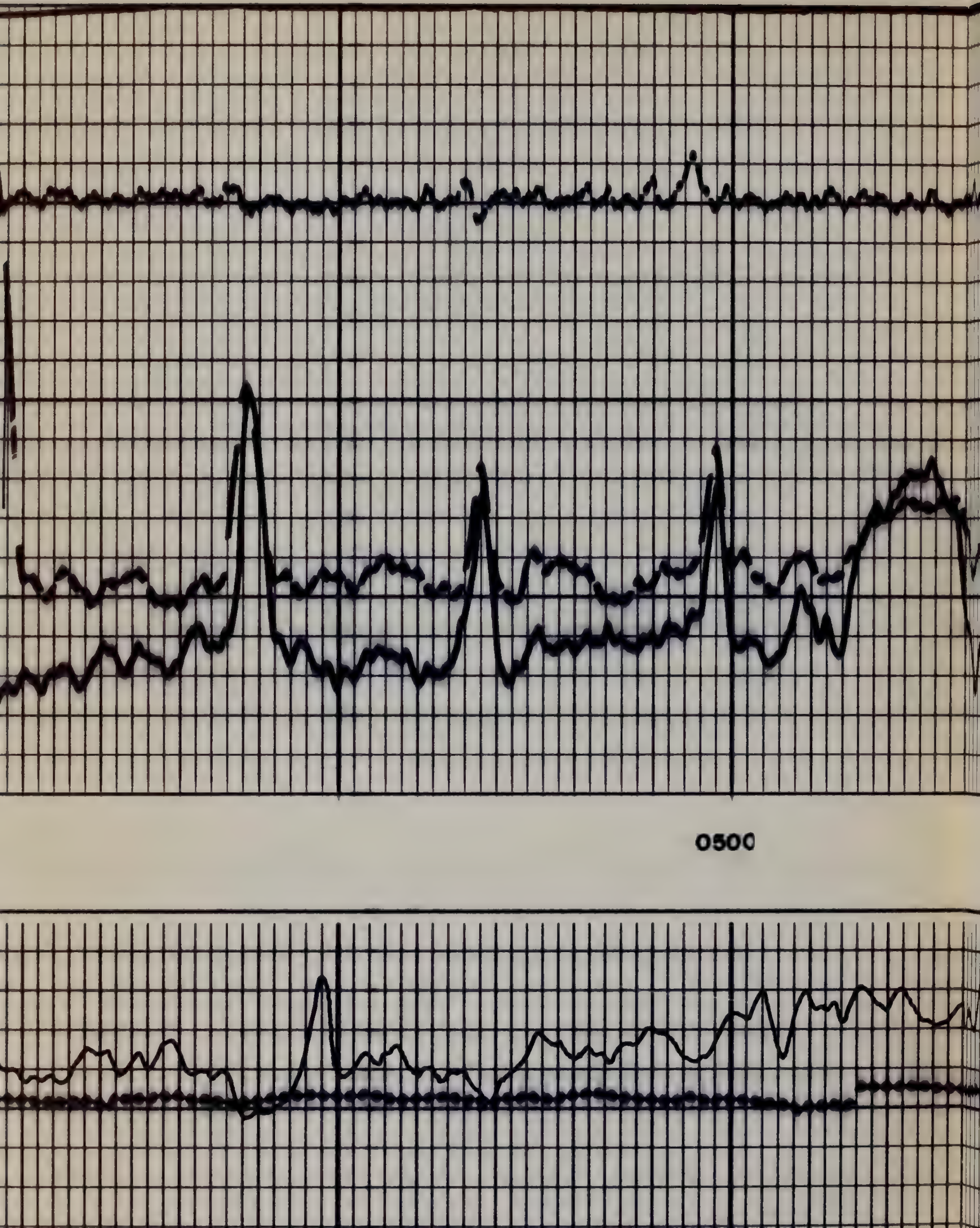
2.0 2.5 3.0

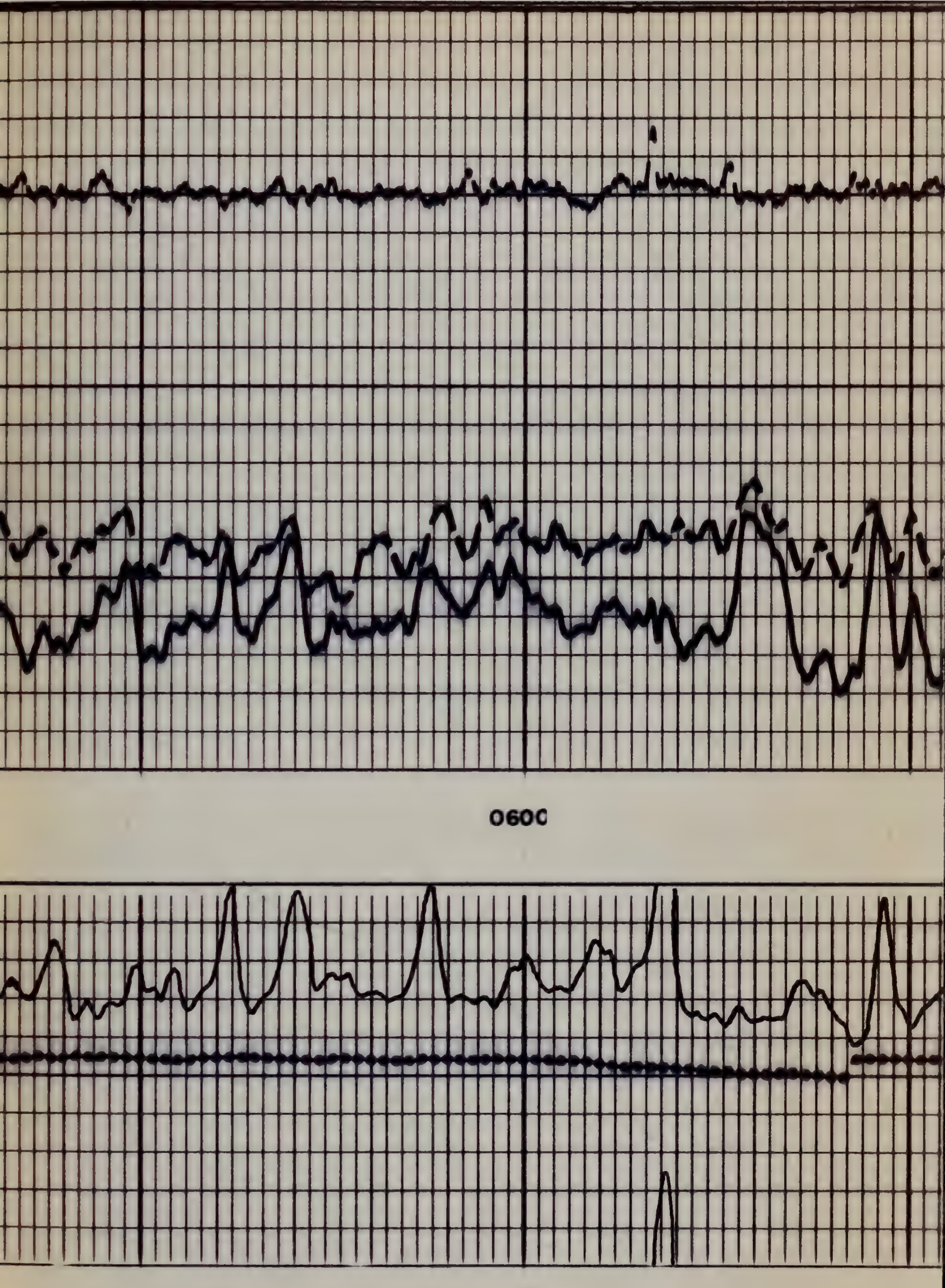
1.0 1.5 2.0

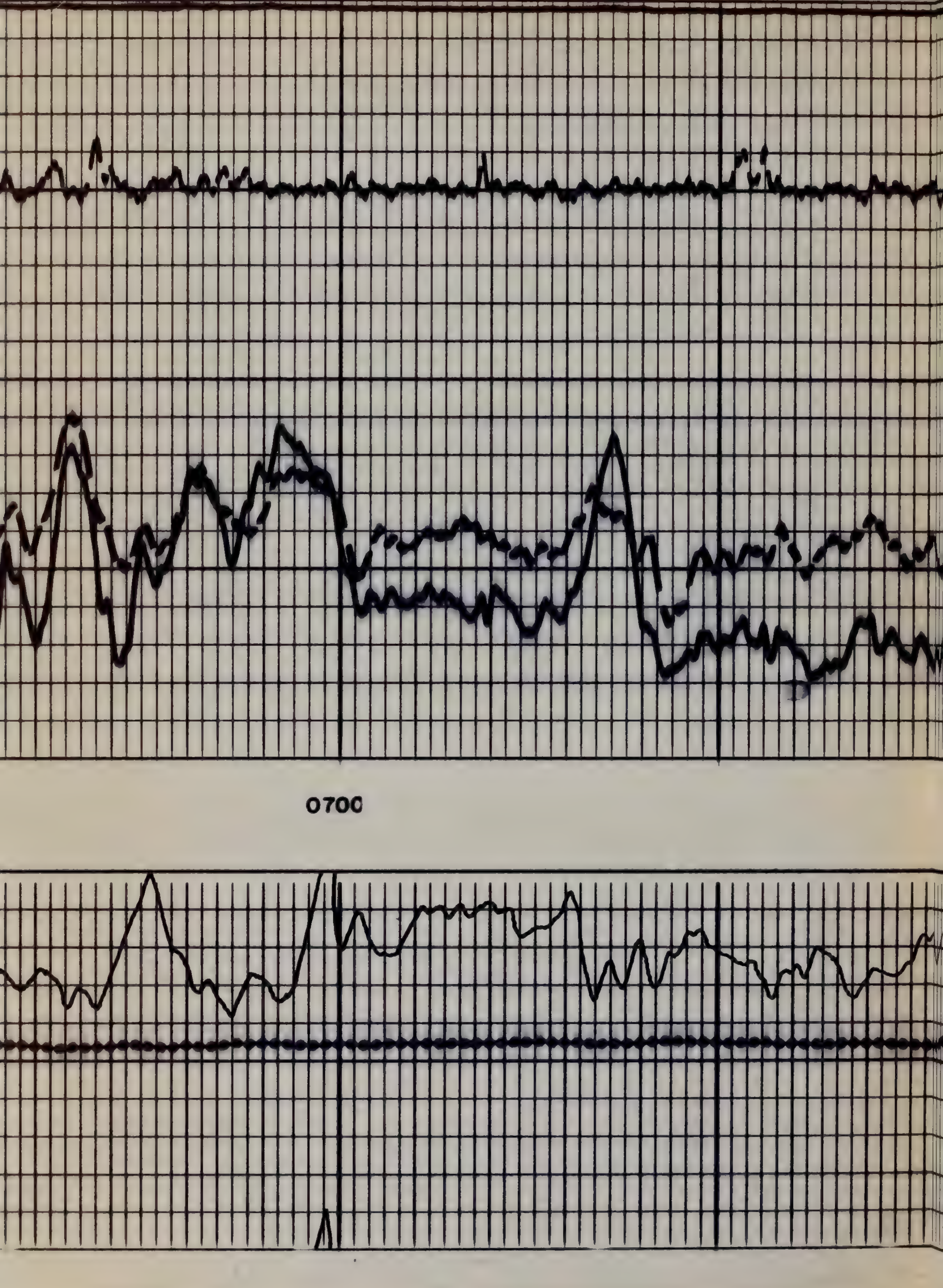
INCREMENTAL WEIGHT LINE

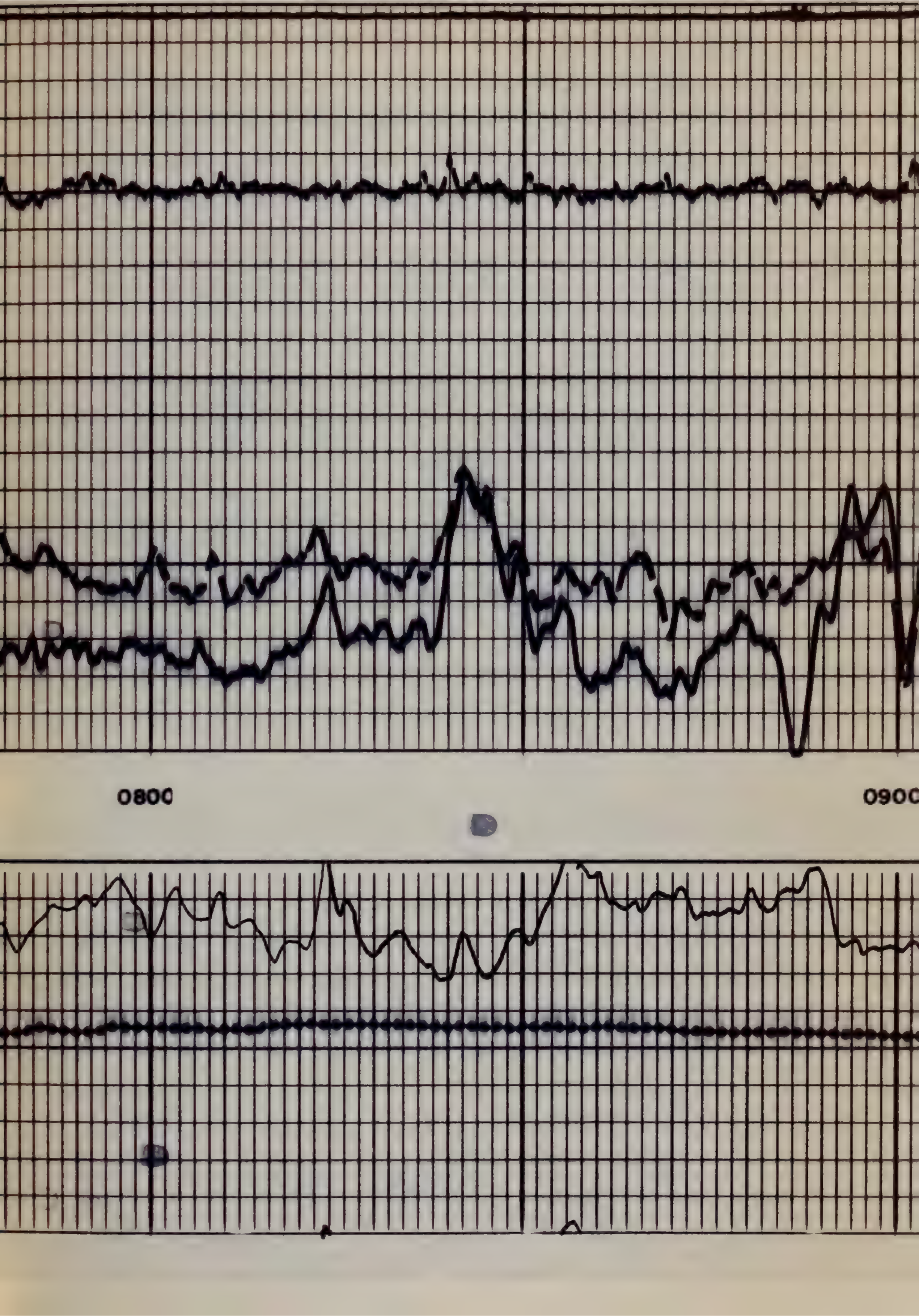

LINE WEIGHT
RATIO
COMPENSATION
BULK DENSITY
Casing
0200
Gamma Ray
Caliper Curve

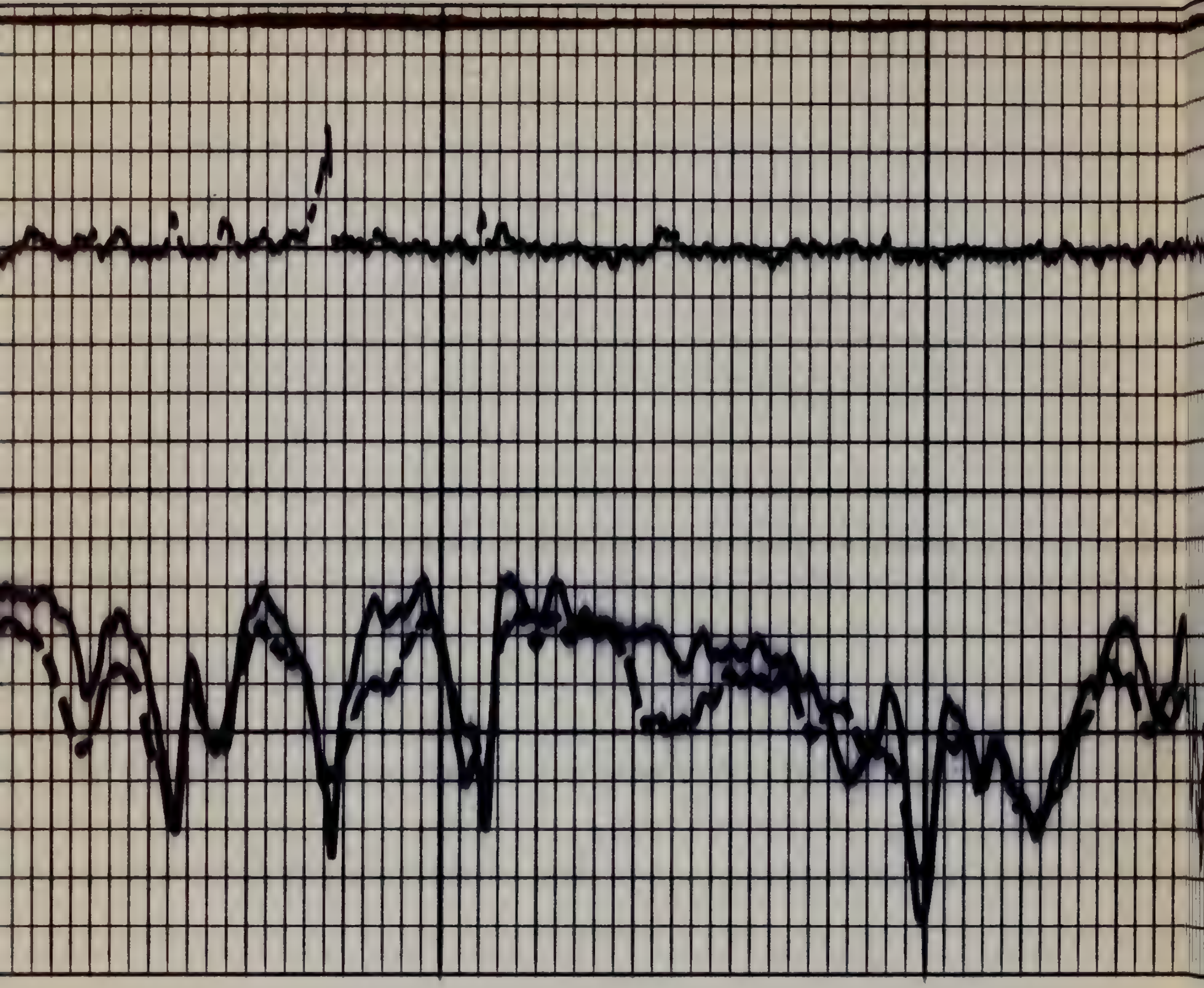

FLUID LEVEL
0300
0400


0500

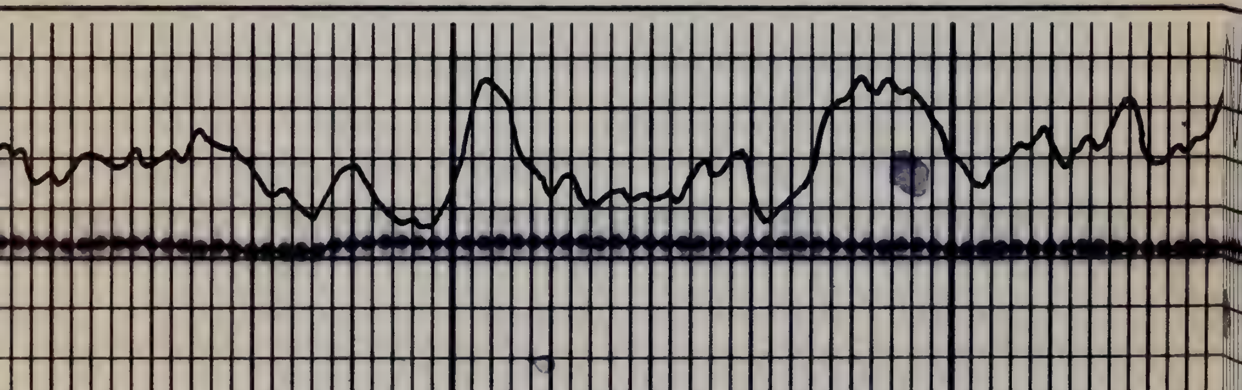

0600

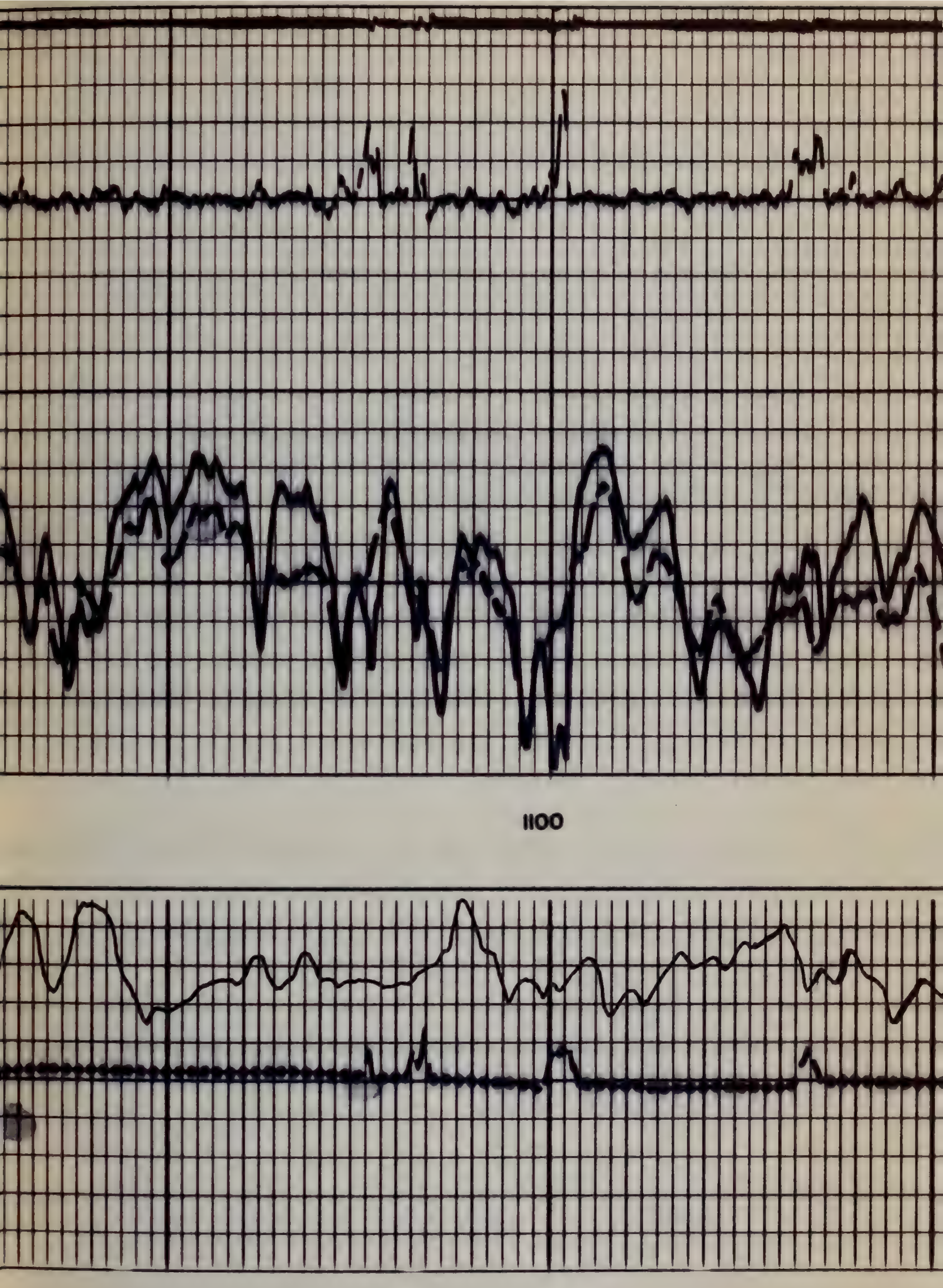

0700

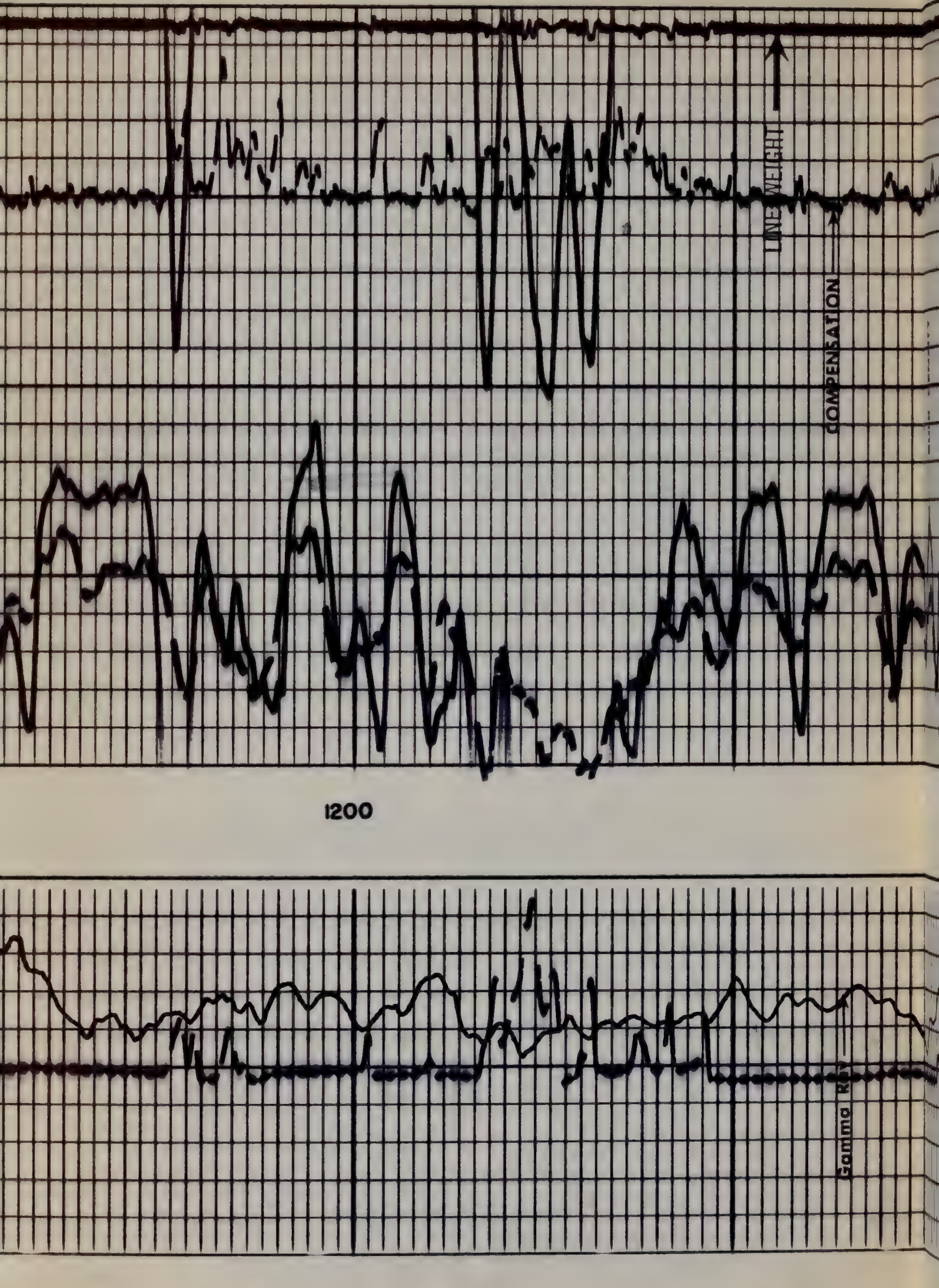

0800
0900

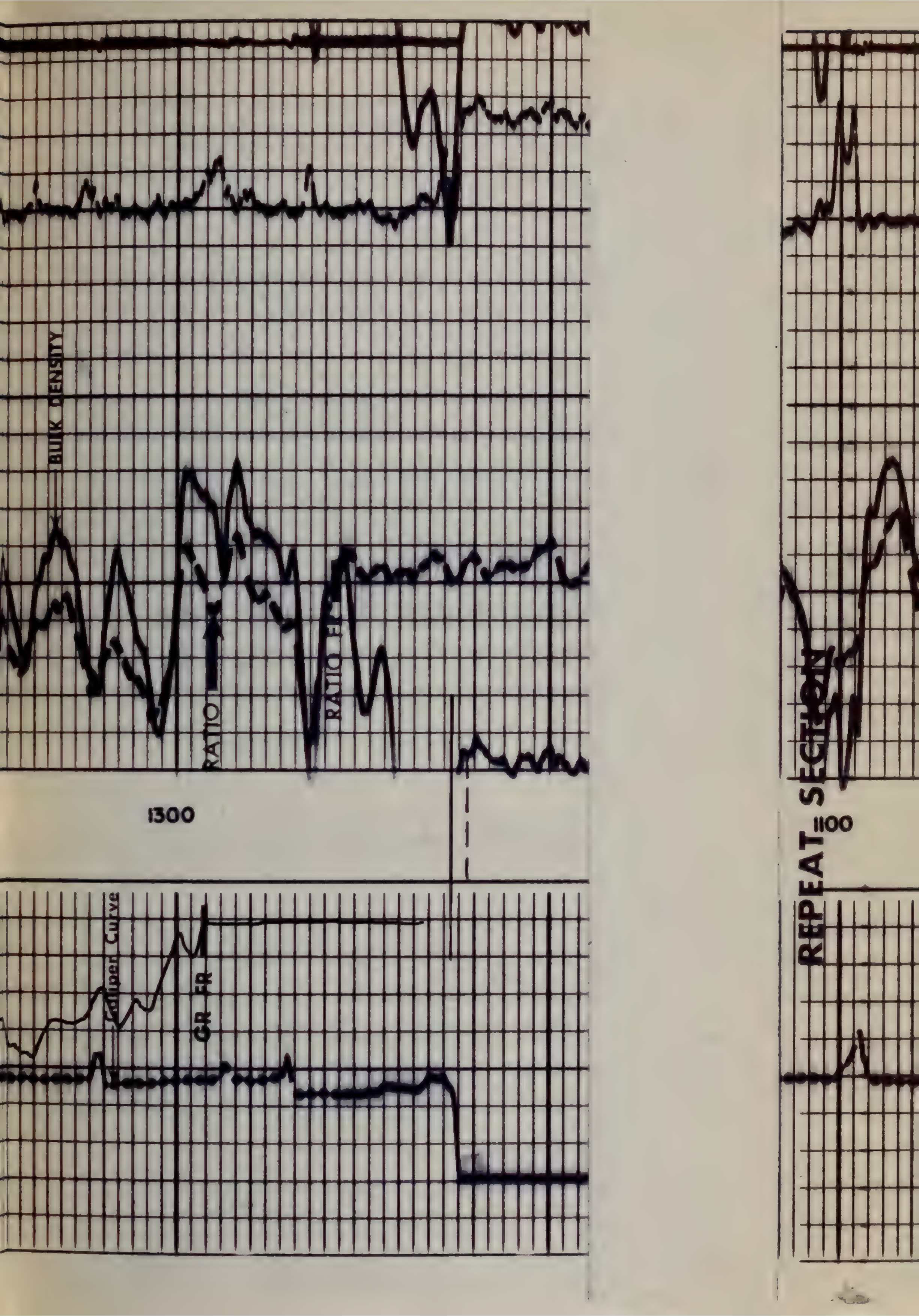


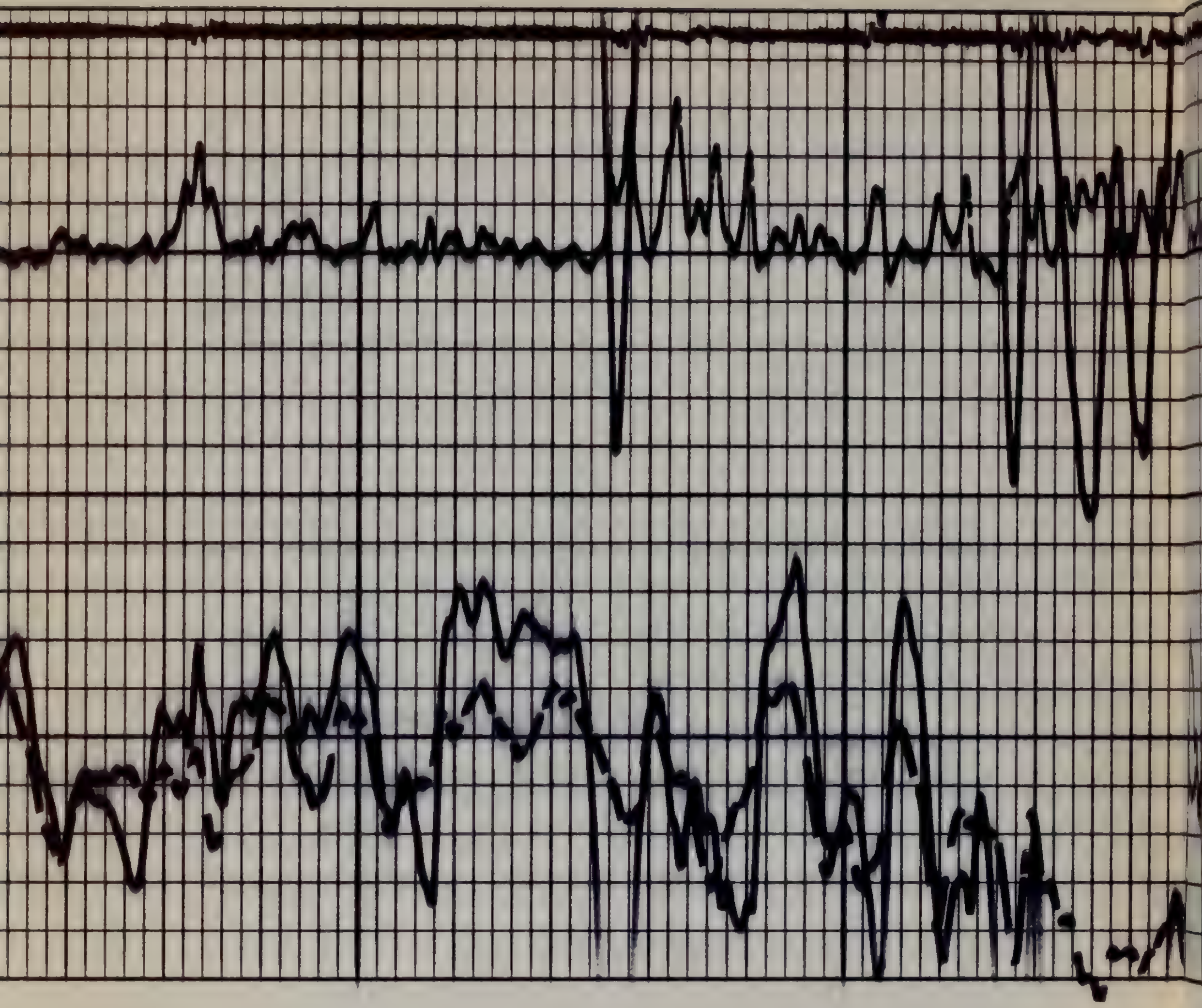
1000



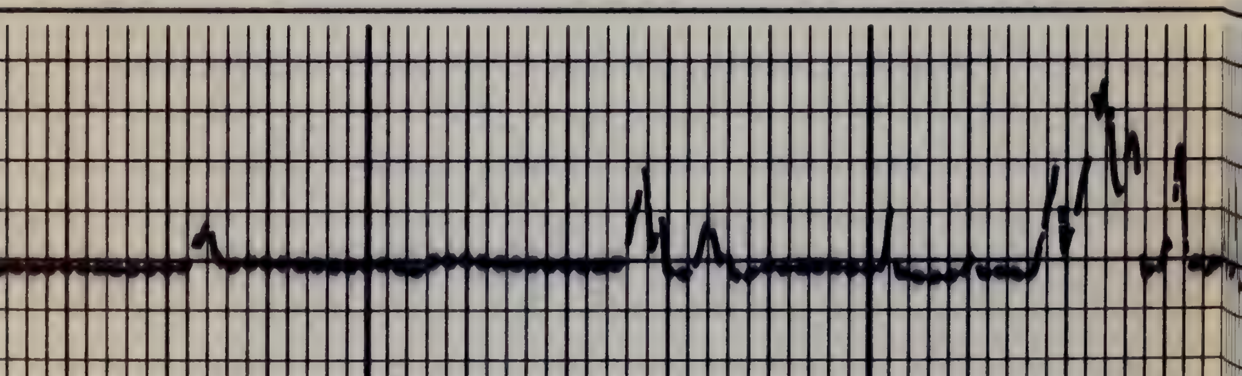

1100

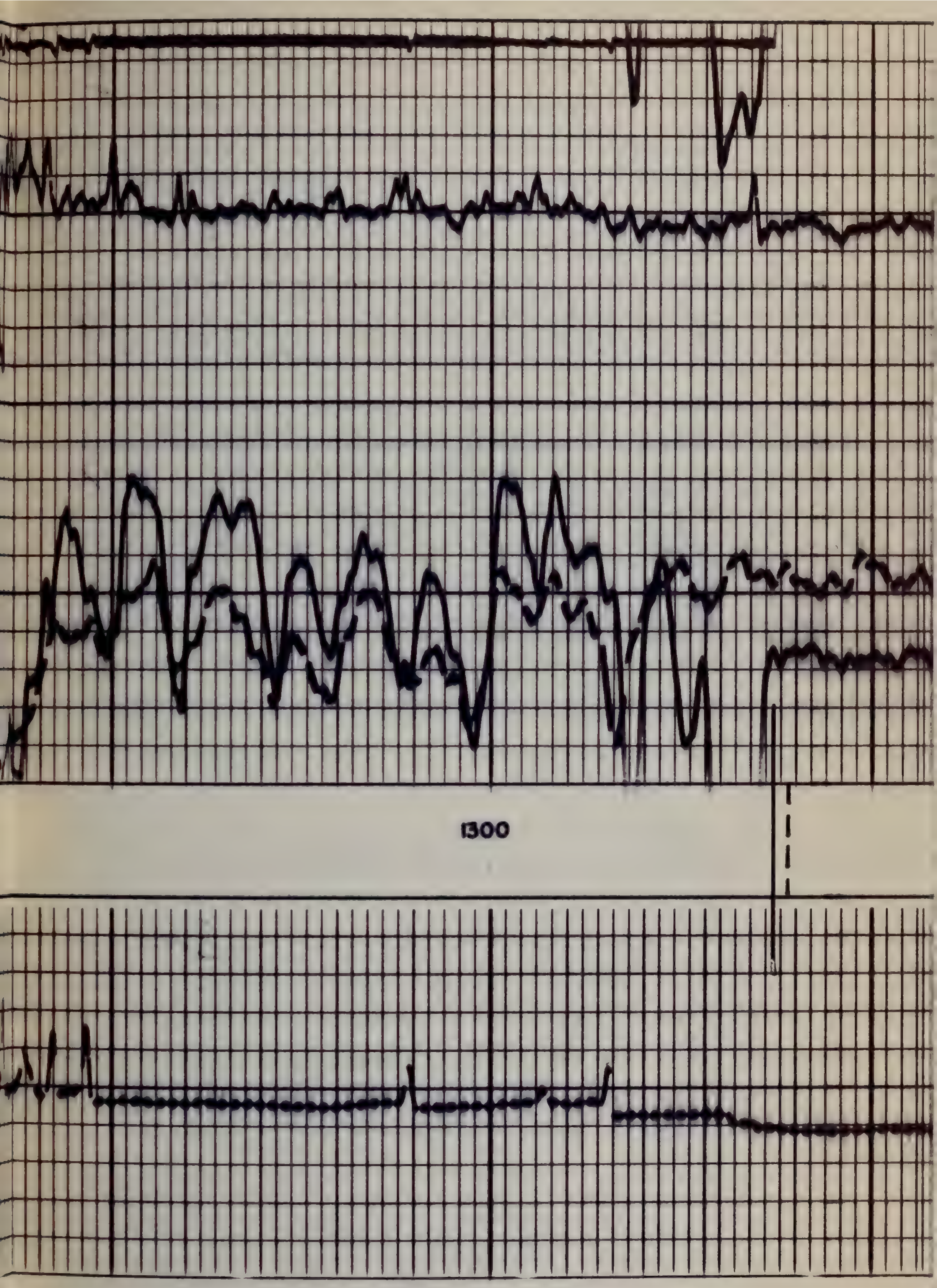

LINE WEIGHT
COMPENSATION
1200
Gamma Ray


BULK DENSITY
RATIO
RATIO FR
1300
Caliper Curve
GR FR
REPEAT SECTION
1100



1200




1300

0 150

150 300

GAMMA RAY

API UNITS

8 18

CALIPER

HOLE DIAM. IN INCHES

DEPTHS

INCREMENTAL WEIGHT LINE

2.0 2.5 3.0

1.0 1.5 2.0

BULK DENSITY

GRAMS/CC.

—.25 0 +.25

CORRECTION

GRAMS/CC.

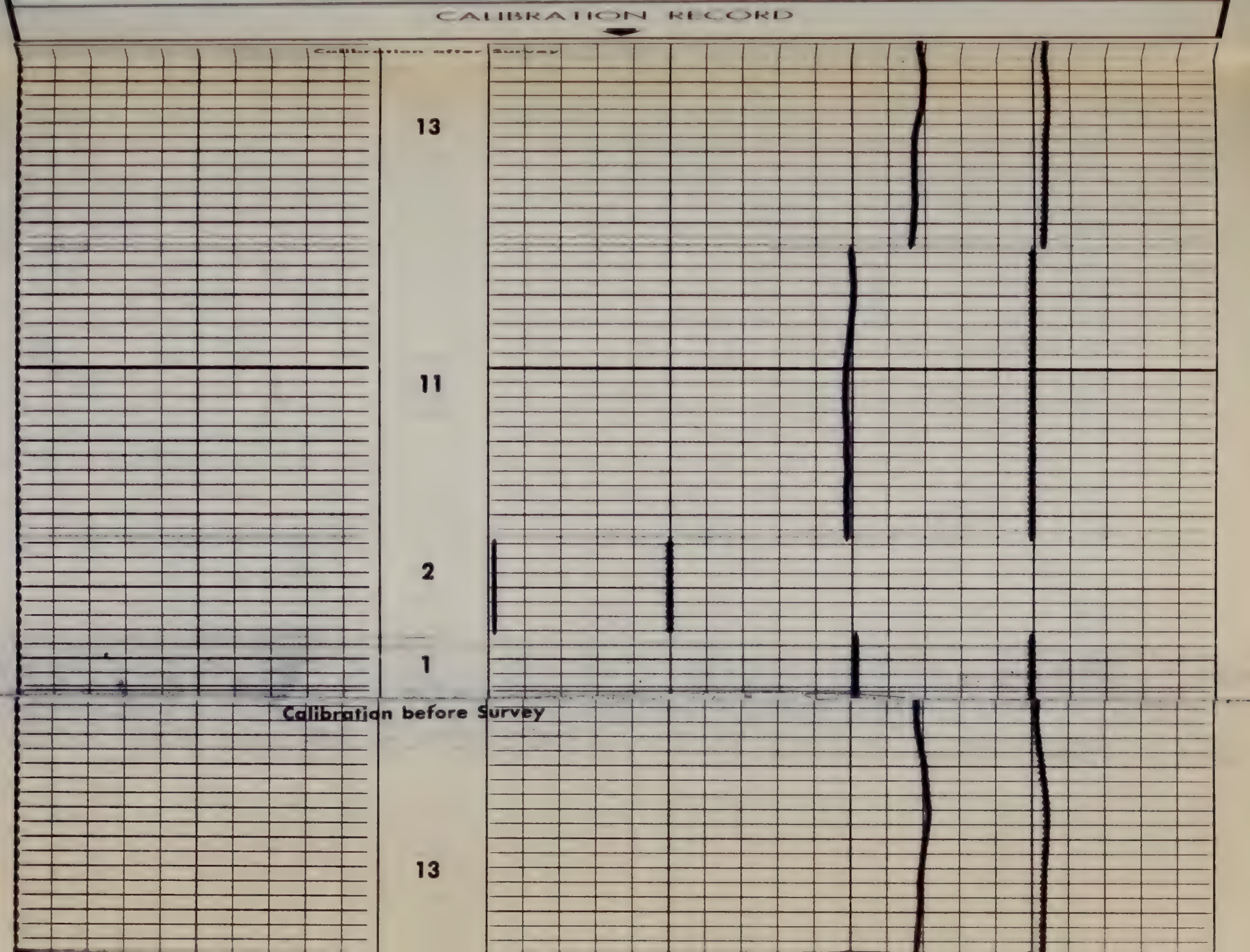
RATIO

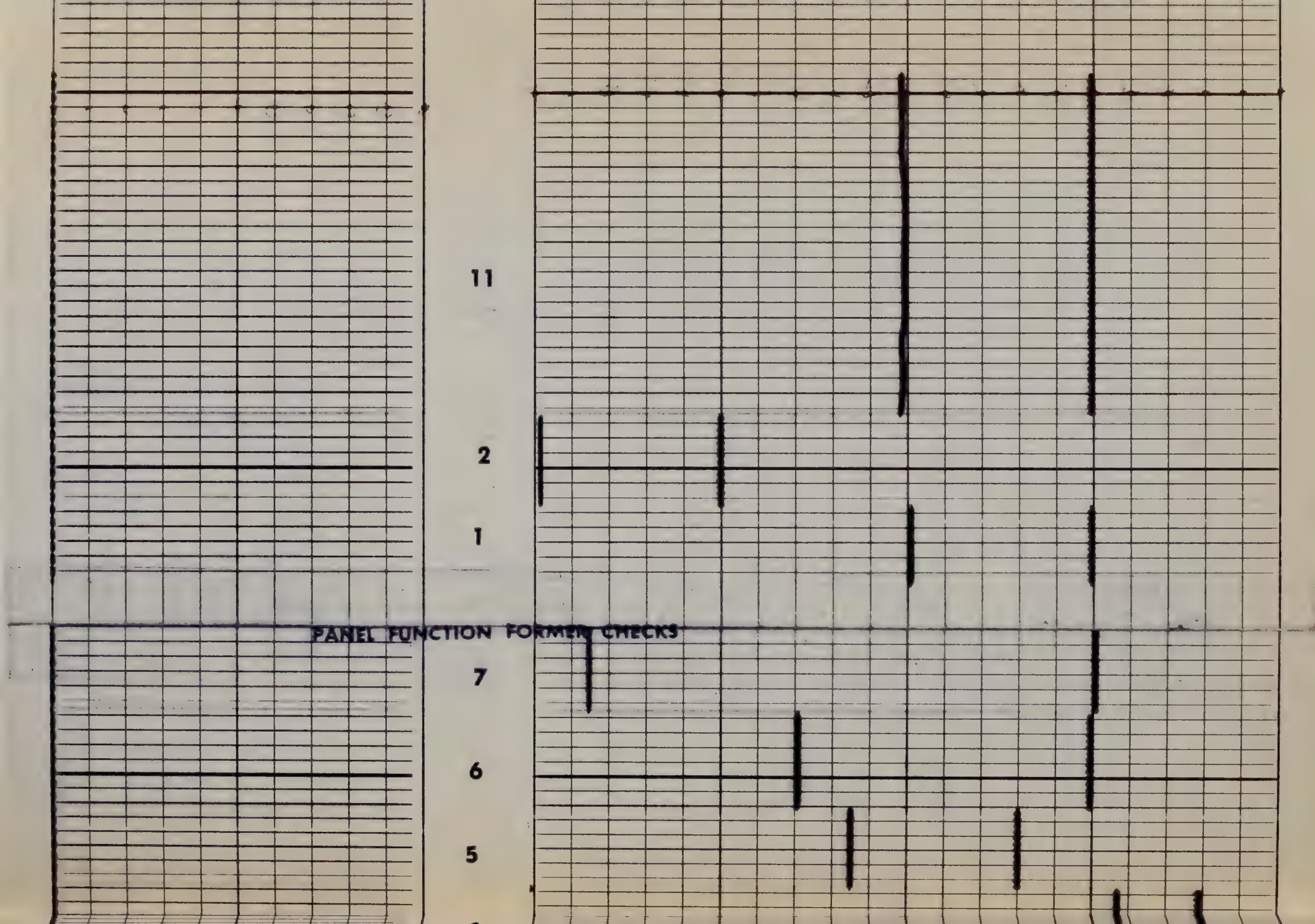
5.0 2.5 0

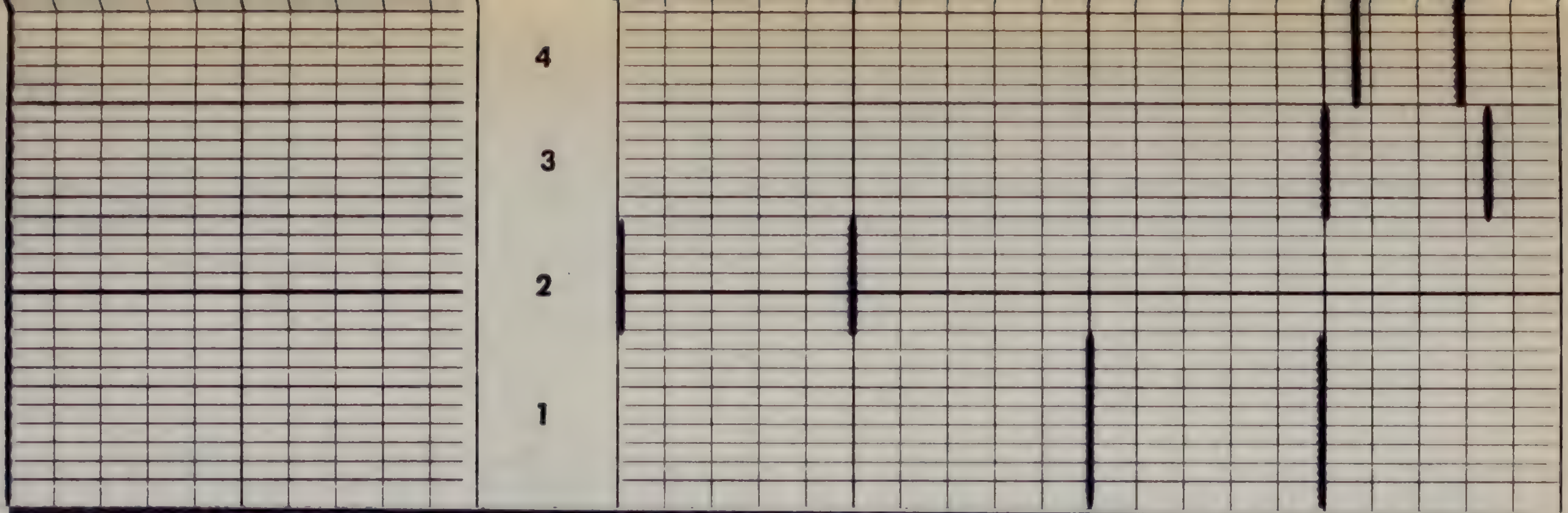
COMPANY ATLANTIC RICHFIELD COMPANY
WELL SORGUM GULCH AQUIFER NO. 1
FIELD
COUNTY RIO BLANCO STATE COLORADO

SCHL. FR 1337
SCHL. TD 1339
DRLR TD 1338
Elev:
KB ----
DF ----
GL 6909

CALIBRATION RECORD


CALIBRATION RECORD
Calibration after Survey
13
11
2
1
Calibration before Survey
13


11
2
1
PANEL FUNCTION FORMER CHECKS
7
6
5



FORMATION DENSITY COMPENSATED CALIBRATION CODING

1. MECHANICAL ZERO
2. RECORDER SENSITIVITY

PANEL TEST

FDC LIQUID

	POS	ρ	$\Delta\rho$
3.	# 1	2.92	.00
4.	# 2	2.78	+.14
5.	# 3	2.42	−.10
6.	# 4	2.35	.00
7.	# 5	2.08	.01

8. MECHANICAL ZERO CALIPER
9. 8″ RING
10. 12″ RING
11. TOOL CALIBRATE # 1 SET $\rho = 2.50$
12. TOOL CALIBRATE # 2 SET $\Delta\rho = .00$
13. LOG POSITION $\rho = 2.59$, $\Delta\rho = .015$

GAMMA RAY CALIBRATION CODING

1. MECHANICAL ZERO
2. ELECTRICAL ZERO
3. RECORDER SENSITIVITY
4. MEMORIZER ADJUSTMENT
5. BACKGROUND
6. CALIBRATE - SOURCE IN PLACE

CALIBRATION RECORD

COMPANY ATLANTIC RICHFIELD COMPANY

WELL SORGUM GULCH AQUIFER NO. 1

FIELD

COUNTY RIO BLANCO STATE COLORADO

SCHL. FR 1337
SCHL. TD 1339
DRLR TD 1338
Elev:
KB ----
DF ----
GL 6909

Schlumberger

SIMULTANEOUS

COMPENSATED NEUTRON-FORMATION DENSITY

COUNTY RIO BLANCO
FIELD or LOCATION SORGUM GULCH
WELL AQUIFER NO. 1
COMPANY ATLANTIC RICHFIELD

COMPANY ATLANTIC RICHFIELD COMPANY

WELL SORGUM GULCH AQUIFER NO. 1

FIELD

COUNTY RIO BLANCO STATE COLORADO

Location: API Serial No. 07174

Sec. 7 Twp. 3S Rge. 96W

Other Services:
DIL TEMP.
FDC-GR
BHC-GR

Permanent Datum: GL ; Elev.: 6909
Log Measured From GL , 0 Ft. Above Perm. Datum
Drilling Measured From GL

Elev.: K.B. ----
D.F. ----
G.L. 6909

Date	7-5-74			
Run No.	ONE			
Depth—Driller	1338			
Depth—Logger	1339			
Btm. Log Interval	1337			
Top Log Interval	162			
Casing—Driller	13-3/8@166	@	@	@
Casing—Logger	162			
Bit Size	12-1/4			
Type Fluid in Hole	WATER			
Fluid Level	410			
Dens. | Visc.	|	|	|	|
pH | Fluid Los	| ml	| ml	| ml	| ml
Source of Sample				
Rmm @ Meas. Temp.	@ °F	@ °F	@ °F	@ °F
Rmf @ Meas. Temp.	@ °F	@ °F	@ °F	@ °F
Rmc @ Meas. Temp.	@ °F	@ °F	@ °F	@ °F
Source: Rmf | Rmc	|	|	|	|
Rm @ BHT	@ °F	@ °F	@ °F	@ °F
Time Since Circ.				
Max. Rec. Temp.	68 °F	°F	°F	°F
Equip. | Location	7674 | VERNAL	|	|	|
Recorded By	HAUGAARD			
Witnessed By	TATE			

The well name, location and borehole reference data were furnished by the customer.

FOLD HERE

SWS-1872-E

CHANGES IN MUD TYPE OR ADDITIONAL SAMPLES

Date | Sample No.				
Depth - Driller				
Type Fluid				
Source of Sample				
Rm @ Meas. Temp.	@	°F	@	°F
Rmf @ Meas. Temp.	@	°F	@	°F
Rmc @ Meas. Temp.	@	°F		
Rm @ BHT	@	°F		
Dens. | Visc.				
ph | Fluid Loss		ml		ml
% Water by Vol.				
% Oil by Vol.				
% Solids by Vol.				
Solids Av. Sp. Gr.				

EQUIPMENT DATA

Run No.	ONE			
Dens. Pnl.	EA-355			
Dens. Cart	EA-263			
Dens. Skid	D-1095			
Dens. Sde	E-235			
Dens. Source	2940			
Dens. Calib.	545			
Neut. Pnl.	A-27			
Neut. Cart	A-26			
Neut. Source	185			
Neut. Calib	A-126			
GR Cart	J-98			
TTR	----			
Mem Pnl.	A-173			

BIT SIZE/CASING DATA

Bit	From	To	Csg. Size	Csg. Wt.	From	To
12-	1338	166	13-		166	SURF.

SCALE CHANGES

Type Log	Depth	Scale Up Hole	Scale Down Hole

LOGGING DATA

CNP

Matrix	Auto Hole Size Corr.	Hole Size Setting (if not auto)	Porosity Scale	From	To
SAND	☒ Yes ☐ No		30/TK	TD	CSG
	☐ Yes ☐ No				
	☐ Yes ☐ No				
	☐ Yes ☐ No				
	☐ Yes ☐ No				

FDC

Liquid Density	Grain Density	Hole Fluid	Porosity Scale	From	To
1.00	2.65	LIQUID	30/TK	TD	CSG

REMARKS

Service Order No. - SO #07174

174			3/4			

CALIBRATION DATA

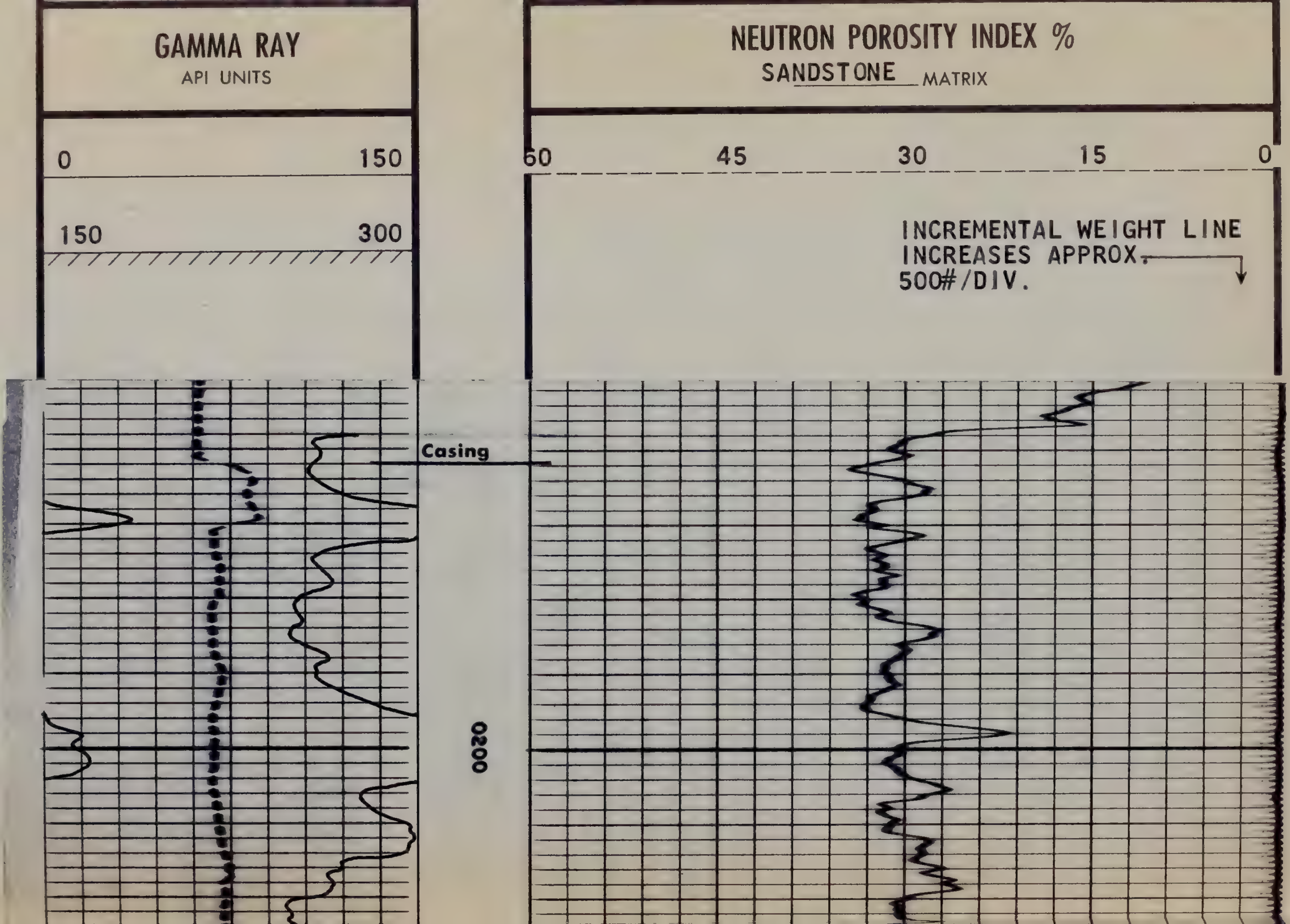
Run No.	Gamma Ray			CNL—Before Log—ACPS		CNL—After Log—ACPS	
	API Scale	Background CPS	Total CPS	Long Spacing	Short Spacing	Long Spacing	Short Spacing
1	0-200	100	500	408	912	408	912
2							
3							
4							
				FDC — Before Log — ACPS		FDC — After Log — ACPS	
1				P_1	P_2	P_1	P_2
2				416	688	416	688
3							
4							

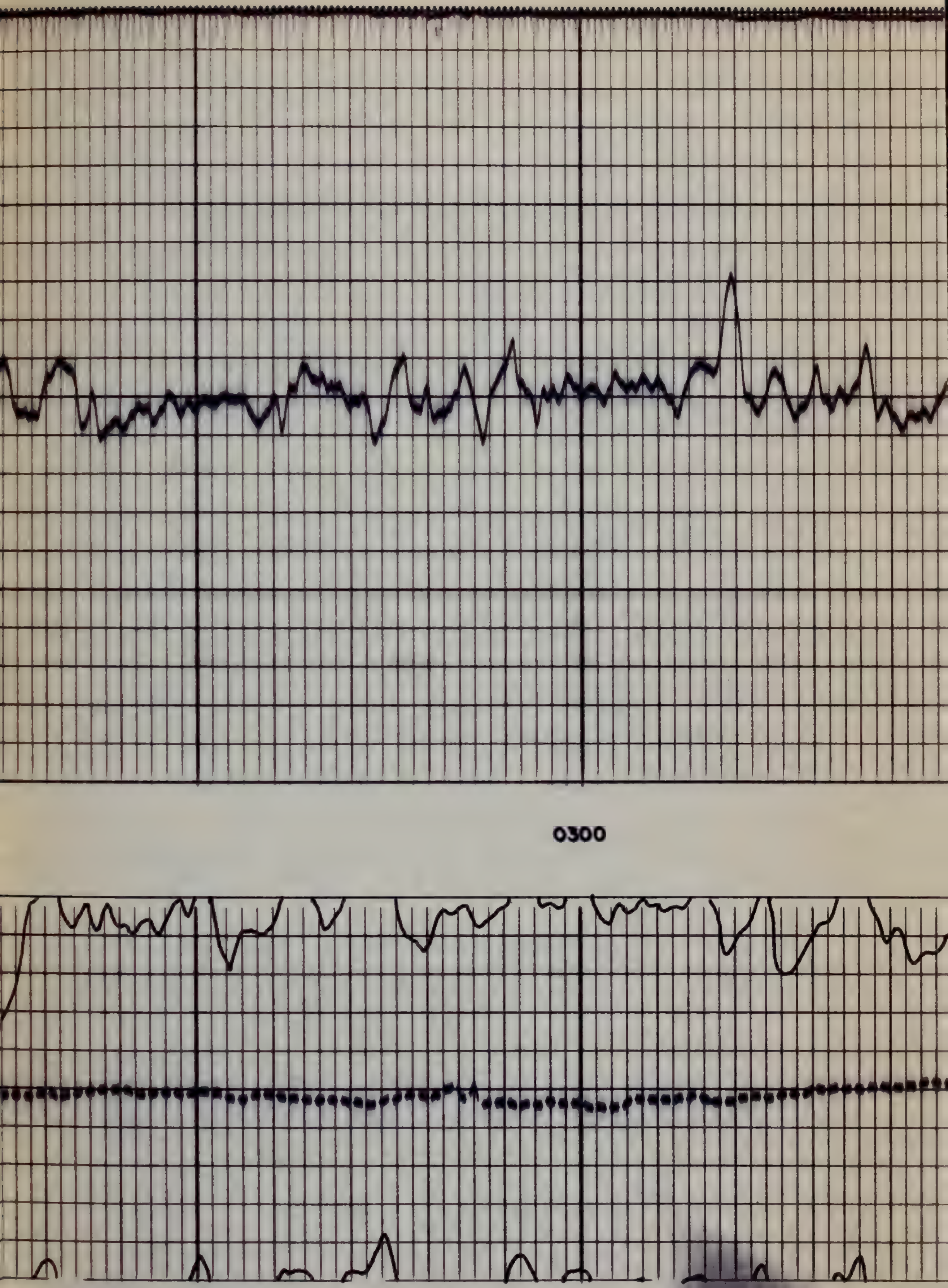
All interpretations are opinions based on inferences from electrical or other measurements and we cannot, and do not guarantee the accuracy or correctness of any interpretations, and we shall not, except in the case of gross or willful negligence on our part, be liable or responsible for any loss, costs, damages or expenses incurred or sustained by anyone resulting from any interpretation made by any of our officers, agents or employees. These interpretations are also subject to Clause 7 of our General Terms and Conditions as set out in our current Price Schedule.

DETAIL LOG

5″ = 100′

CALIPER HOLE DIAM. IN INCHES	DEPTHS	DENSITY POROSITY INDEX % SANDSTONE MATRIX
8 — 18		60 — 45 — 30 — 15 — 0


GAMMA RAY
API UNITS
0
150
150
300
NEUTRON POROSITY INDEX %
SANDSTONE MATRIX
60
45
30
15
0
INCREMENTAL WEIGHT LINE
INCREASES APPROX.
500#/DIV.
Casing
0200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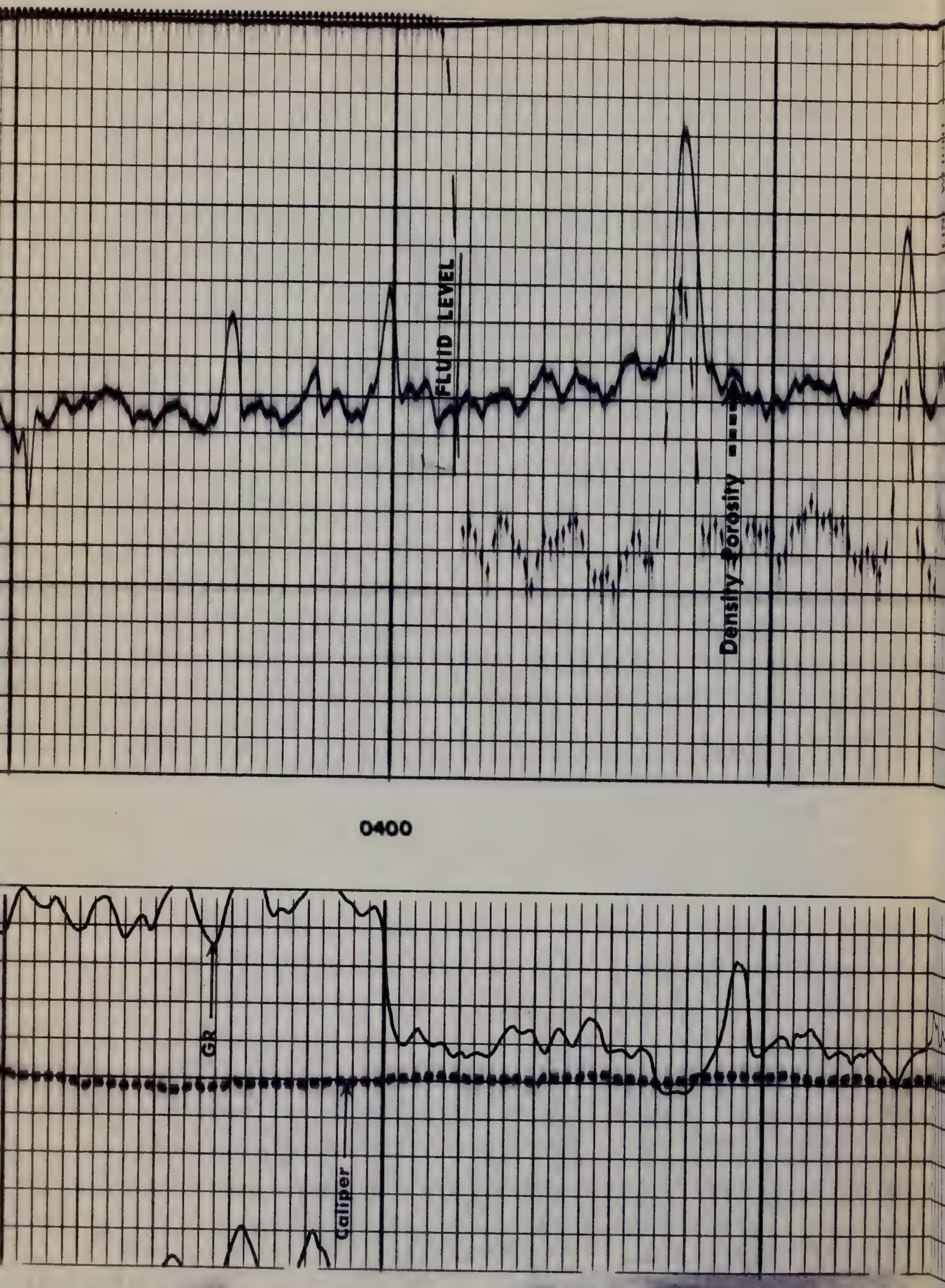
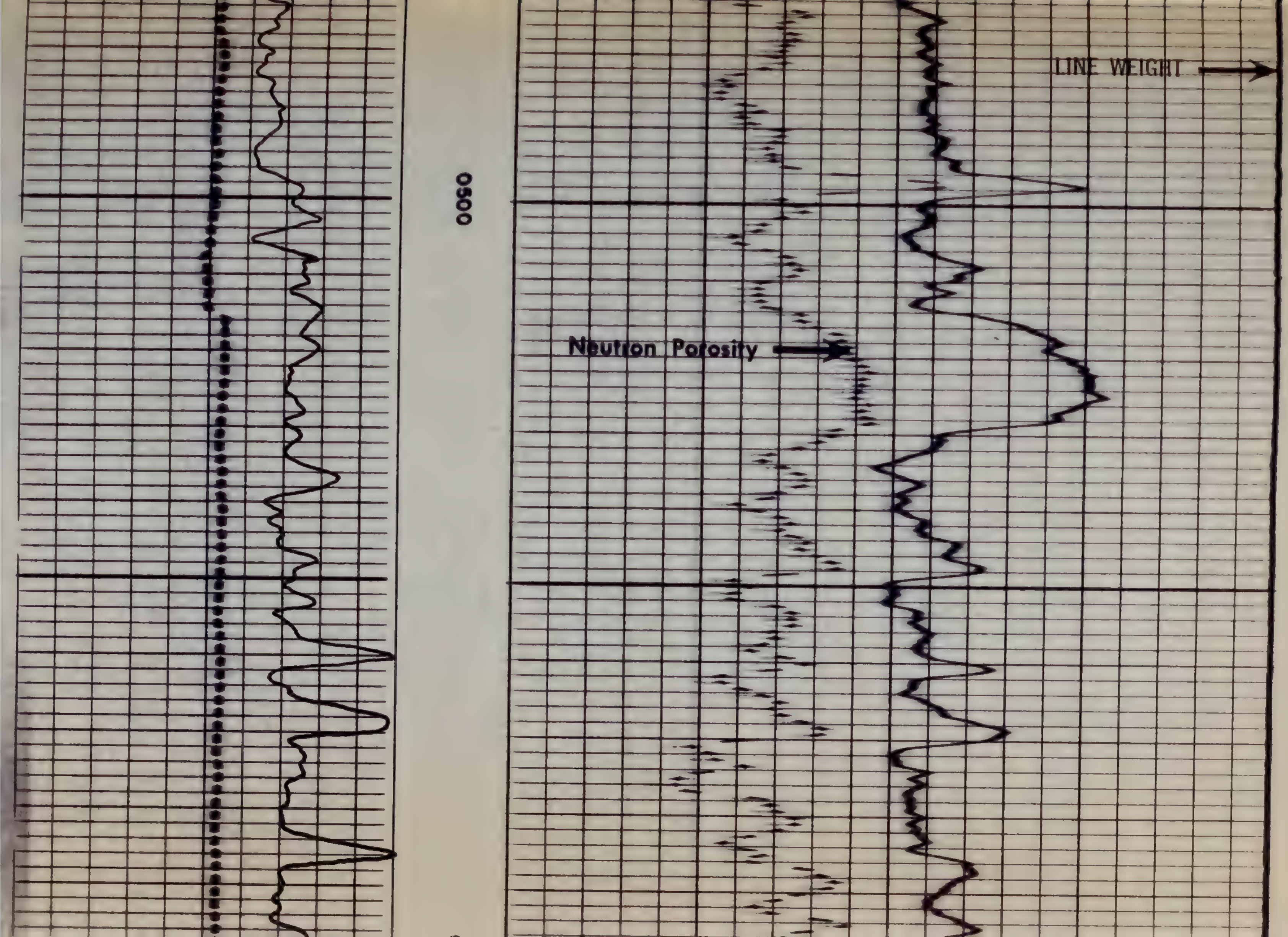
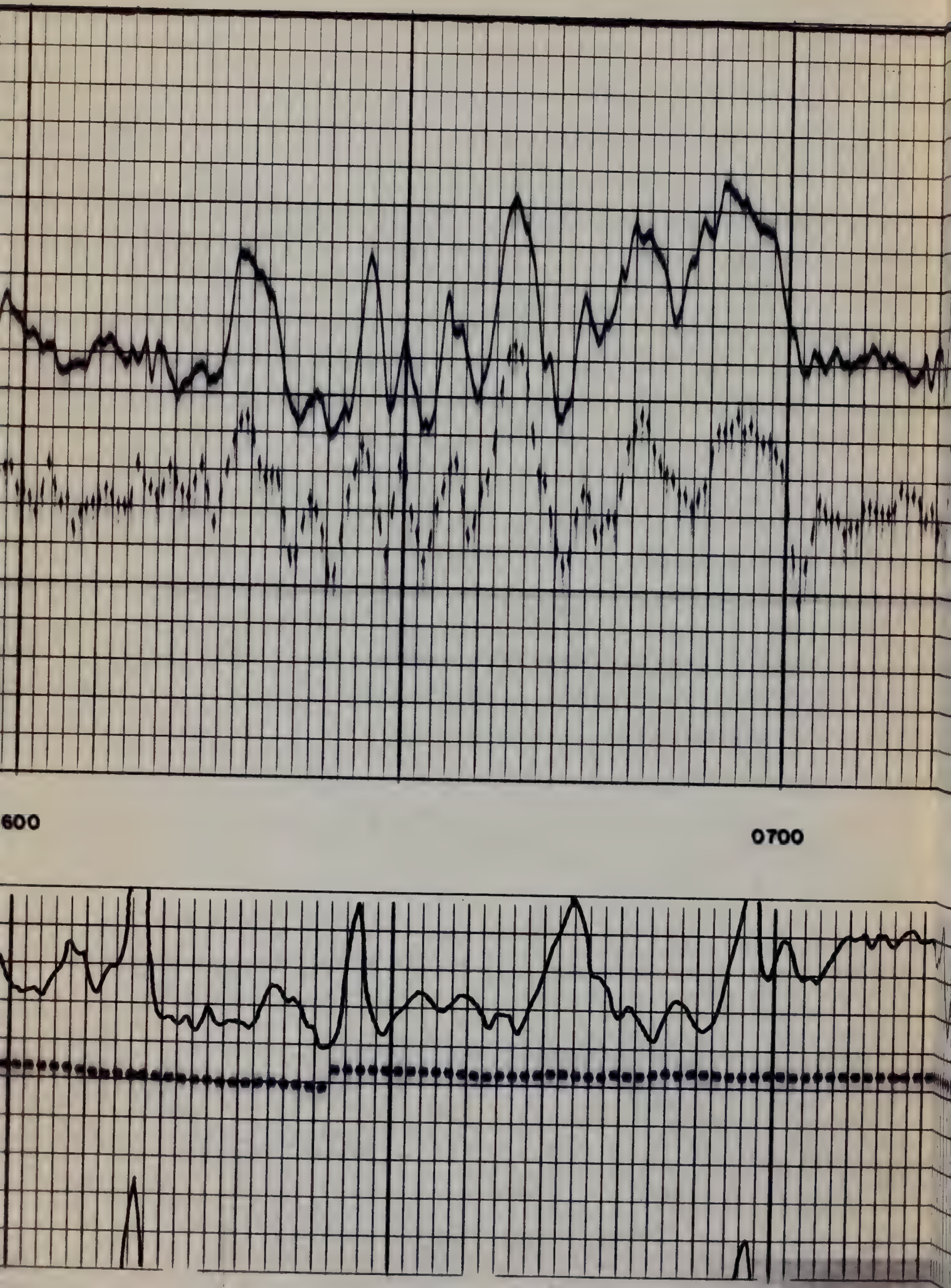

FLUID LEVEL
Density Porosity
0400
GR
Caliper


LINE WEIGHT
Neutron Porosity
0500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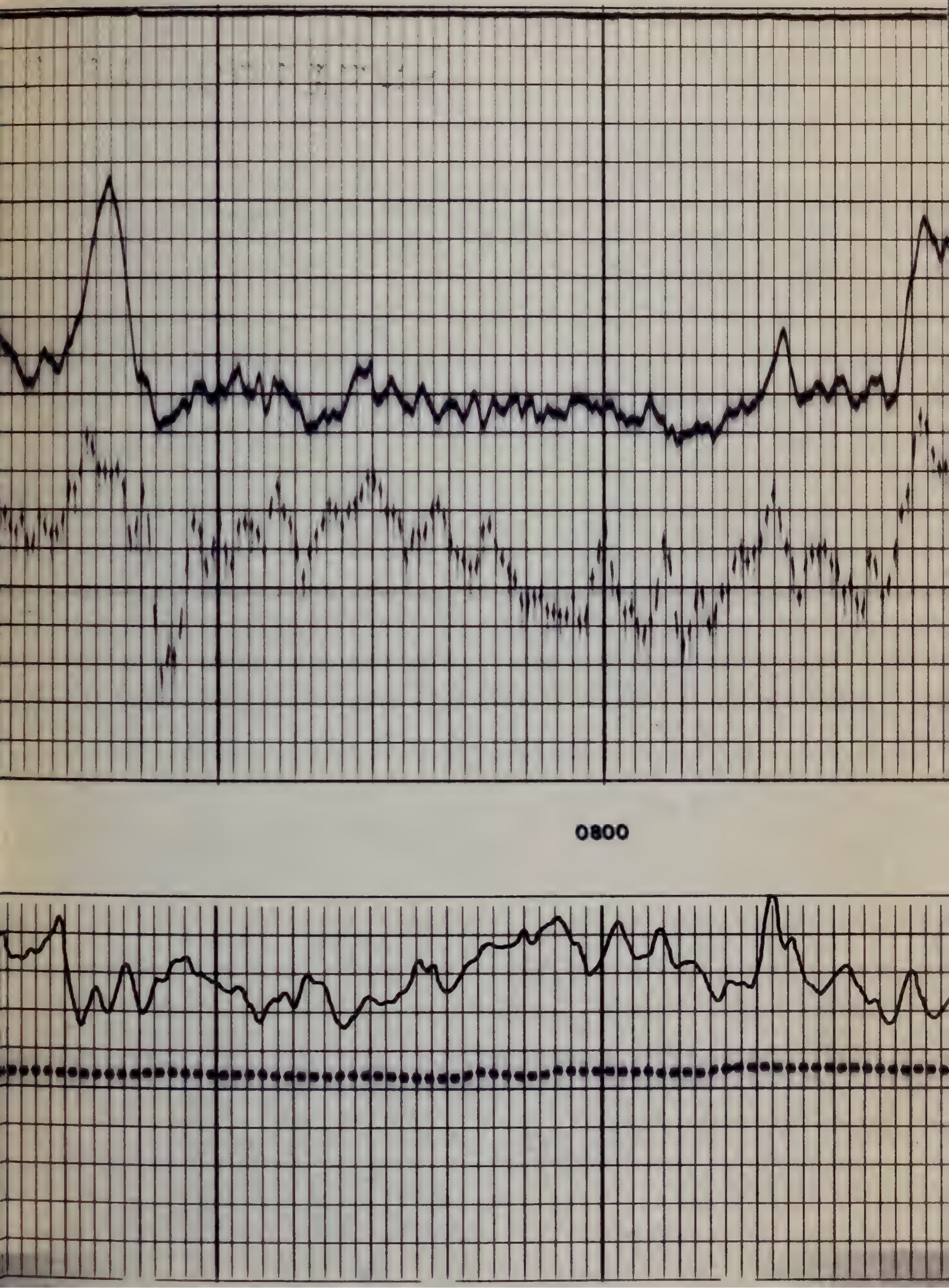
0700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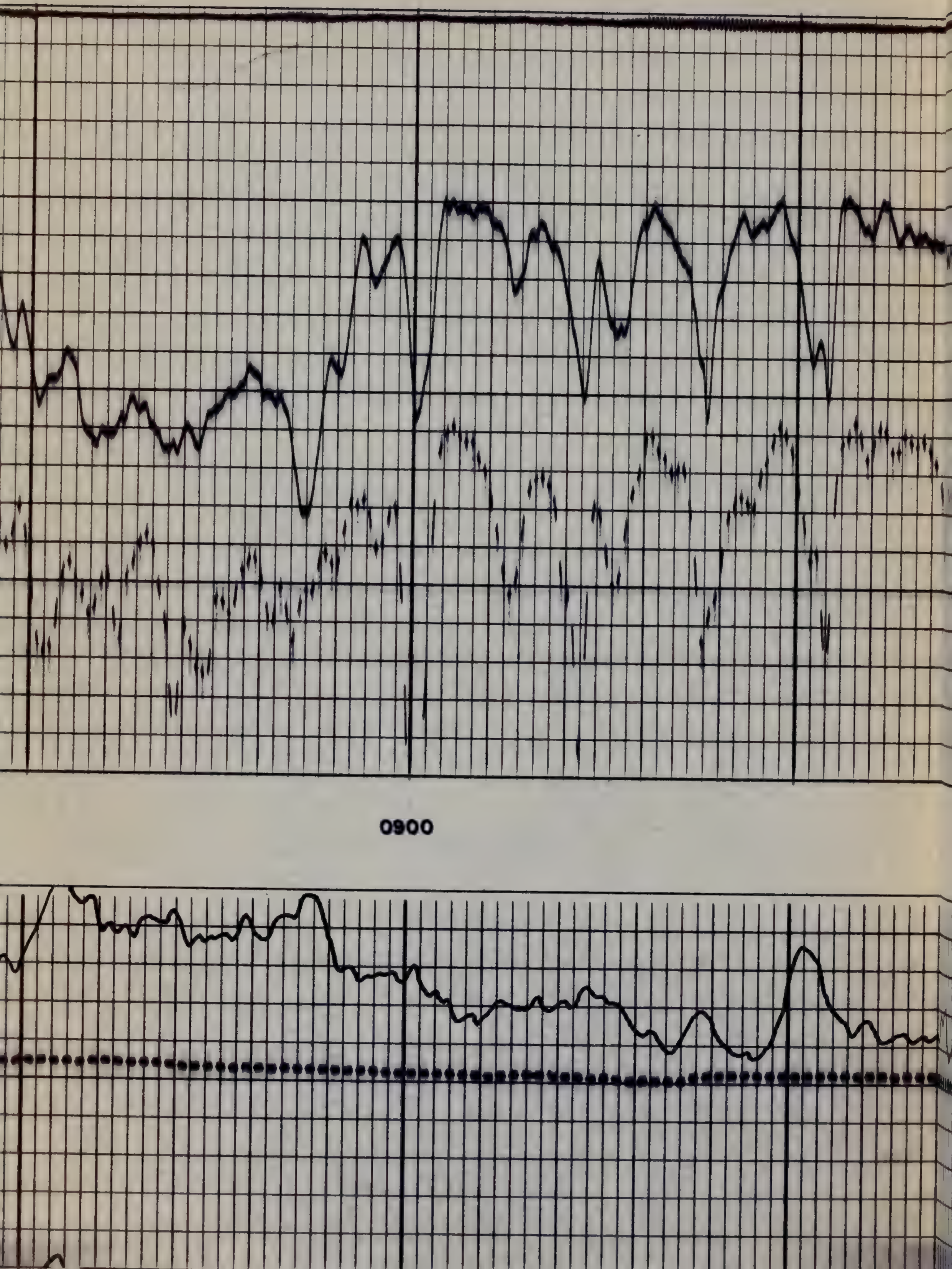
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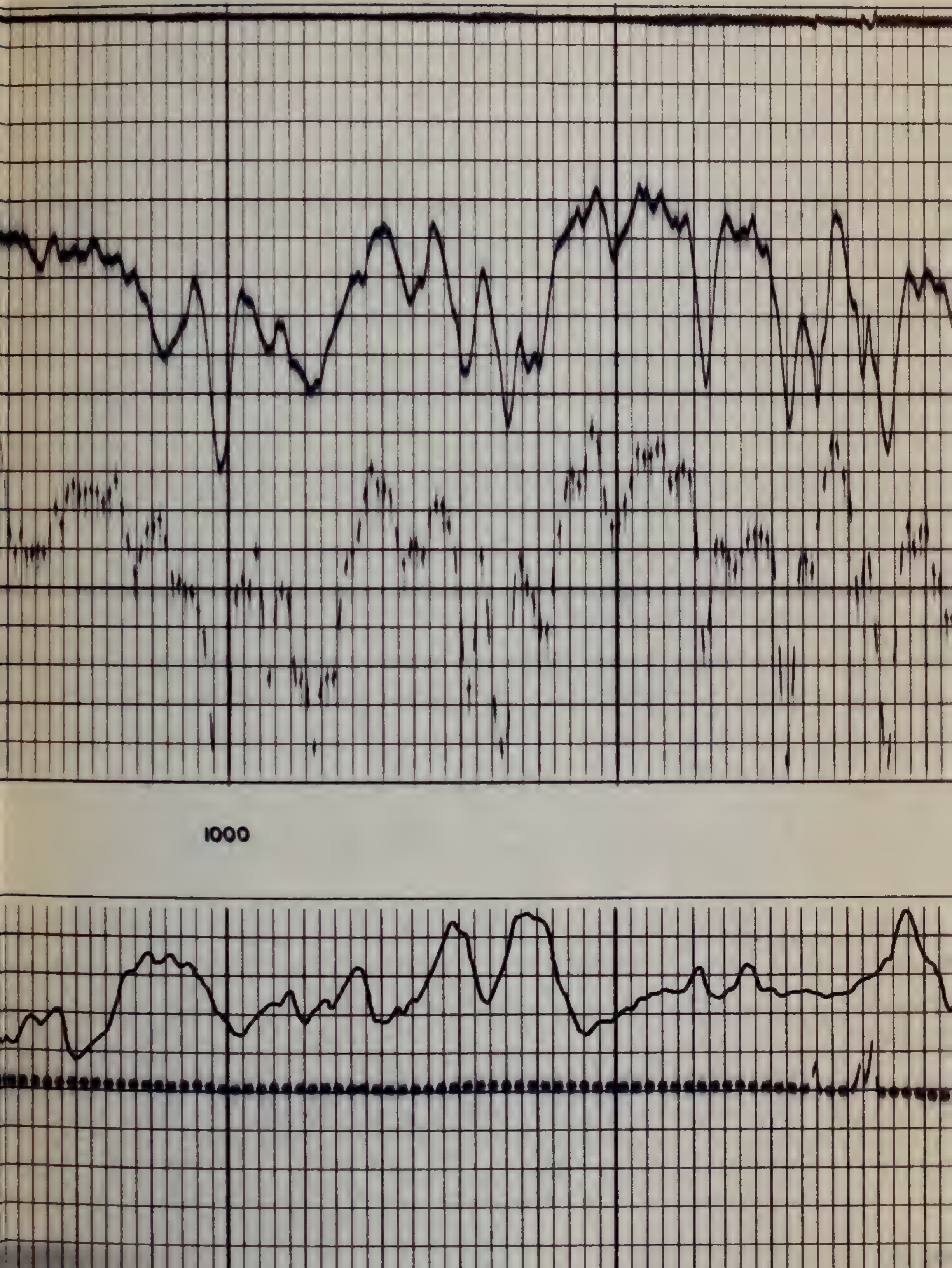
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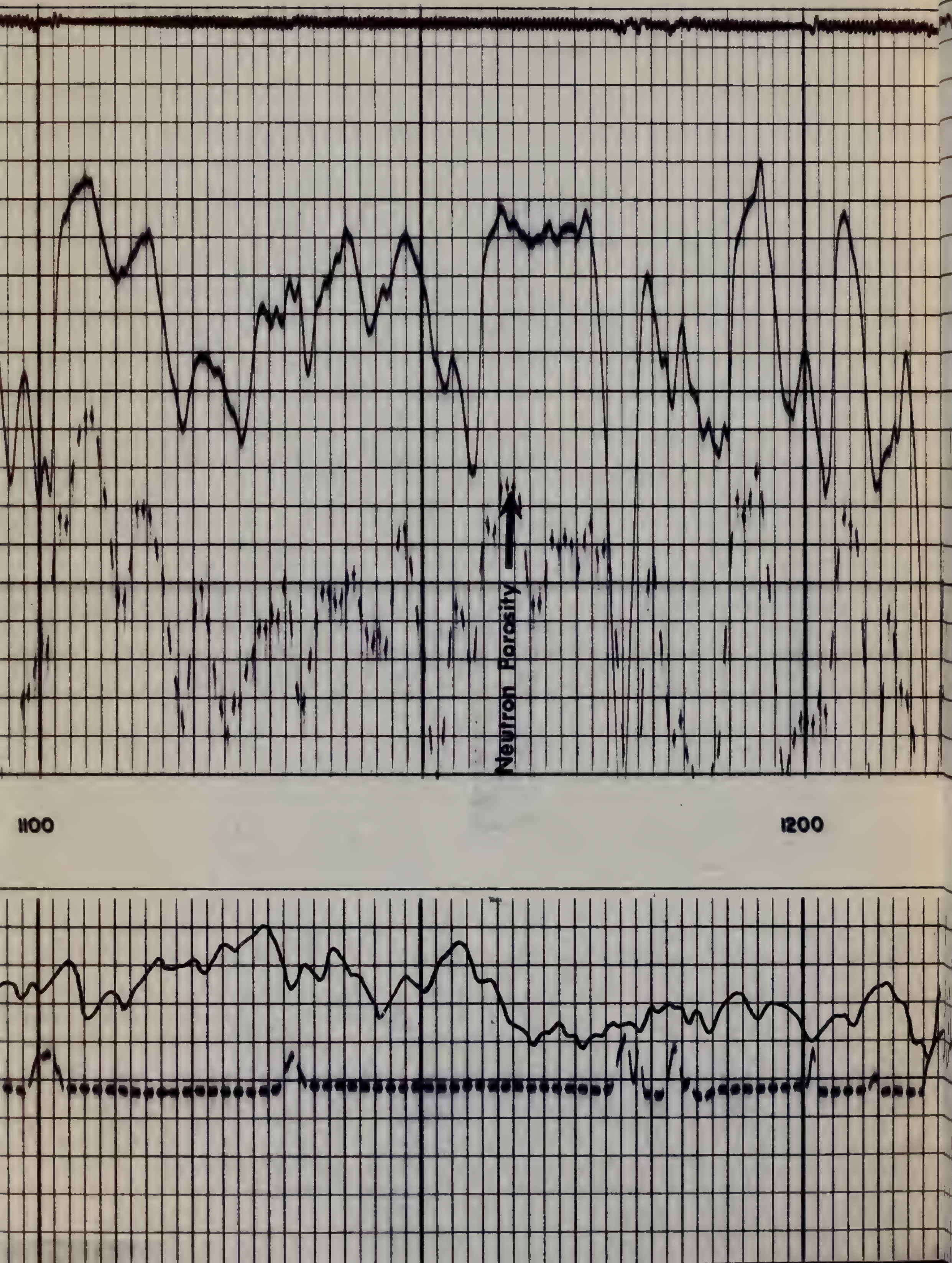
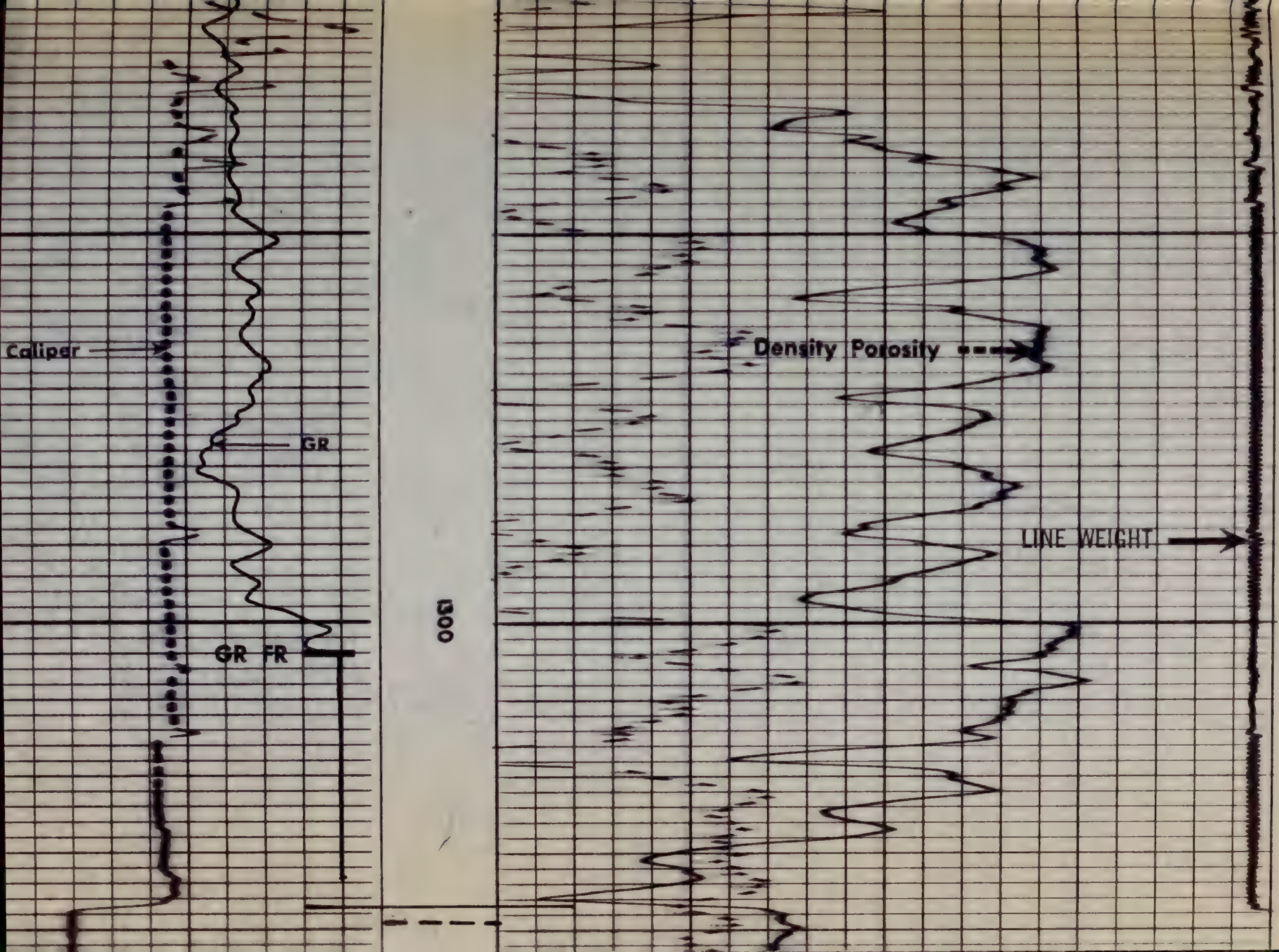
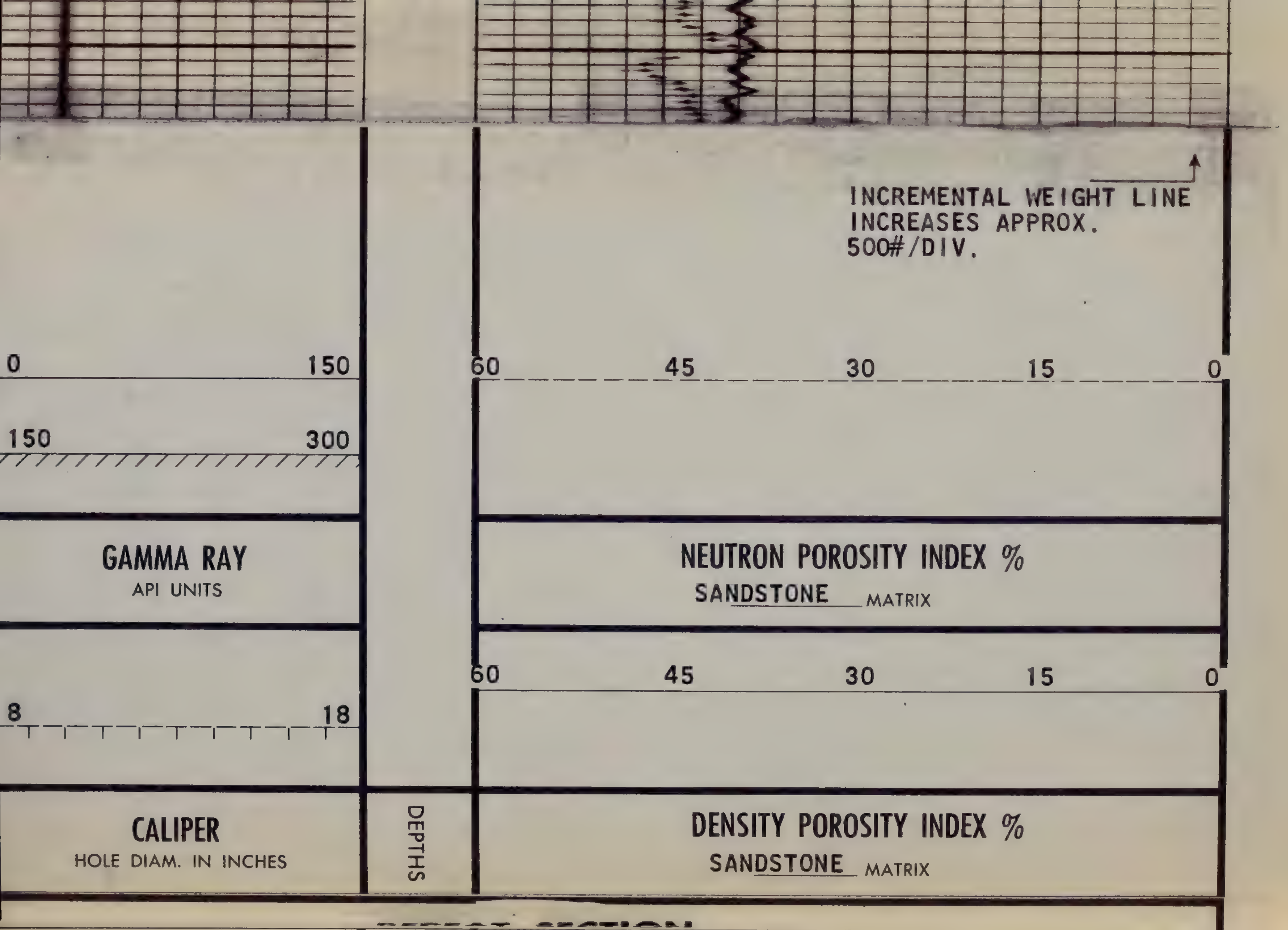
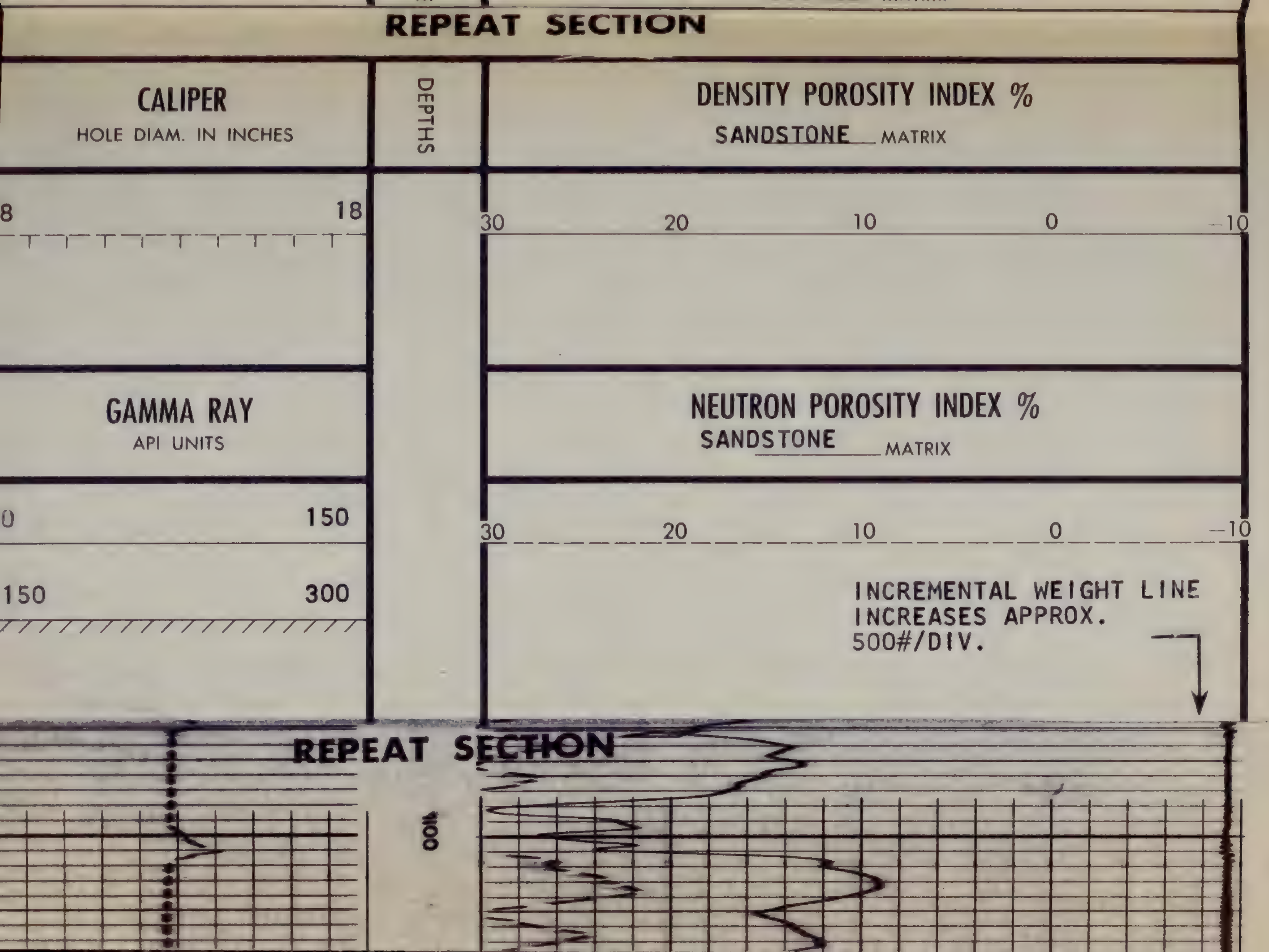
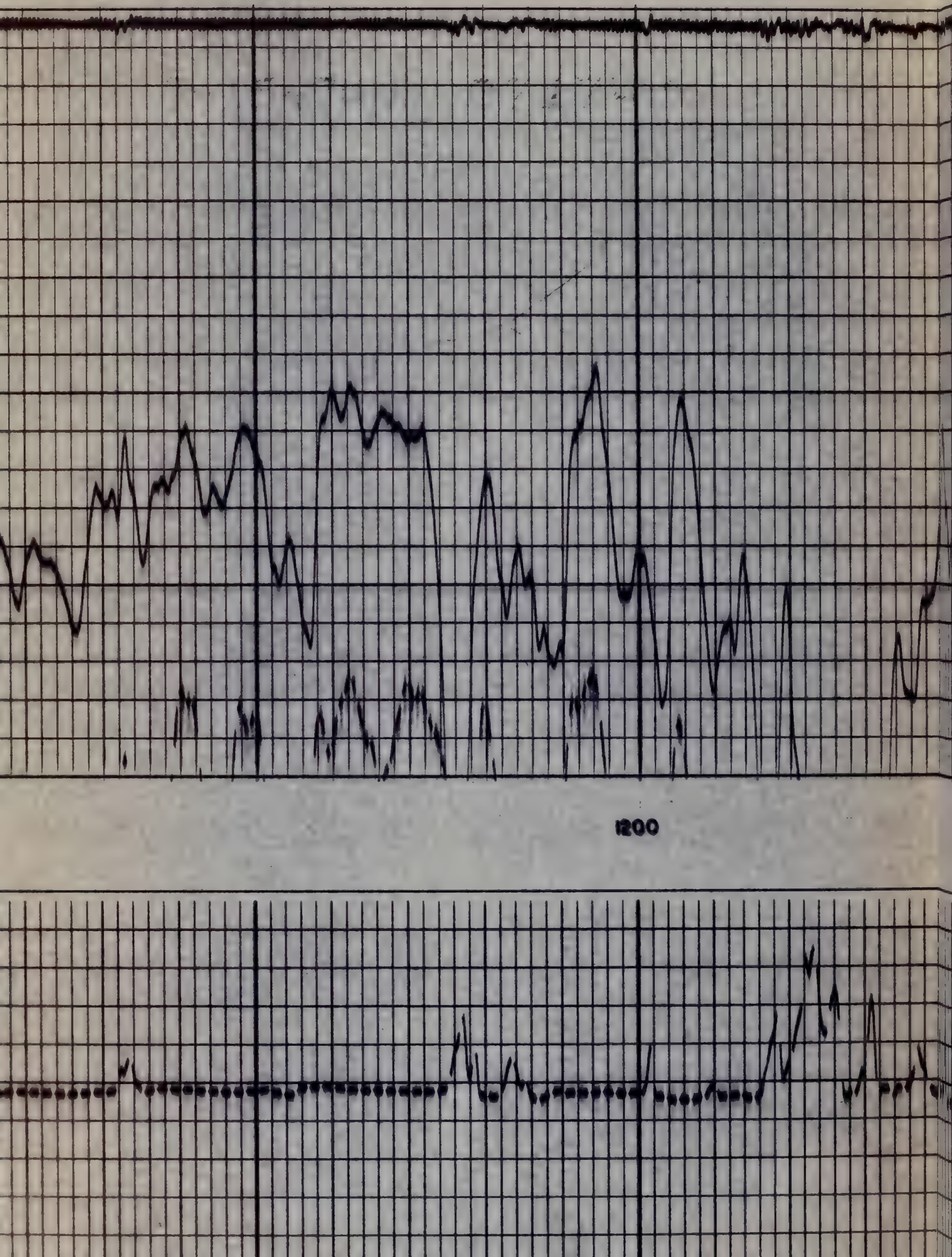

Neutron Porosity
1100
1200


Caliper
GR
GR FR
1300
Density Porosity
LINE WEIGHT


INCREMENTAL WEIGHT LINE
INCREASES APPROX.
500#/DIV.
0
150
150
300
GAMMA RAY
API UNITS
8
18
CALIPER
HOLE DIAM. IN INCHES
DEPTHS
60
45
30
15
0
NEUTRON POROSITY INDEX %
SANDSTONE MATRIX
60
45
30
15
0
DENSITY POROSITY INDEX %
SANDSTONE MATRIX


REPEAT SECTION
CALIPER
HOLE DIAM. IN INCHES
DEPTHS
DENSITY POROSITY INDEX %
SANDSTONE MATRIX
8
18
30
20
10
0
−10
GAMMA RAY
API UNITS
NEUTRON POROSITY INDEX %
SANDSTONE MATRIX
0
150
150
300
30
20
10
0
−10
INCREMENTAL WEIGHT LINE
INCREASES APPROX.
500#/DIV.
REPEAT SECTION
1100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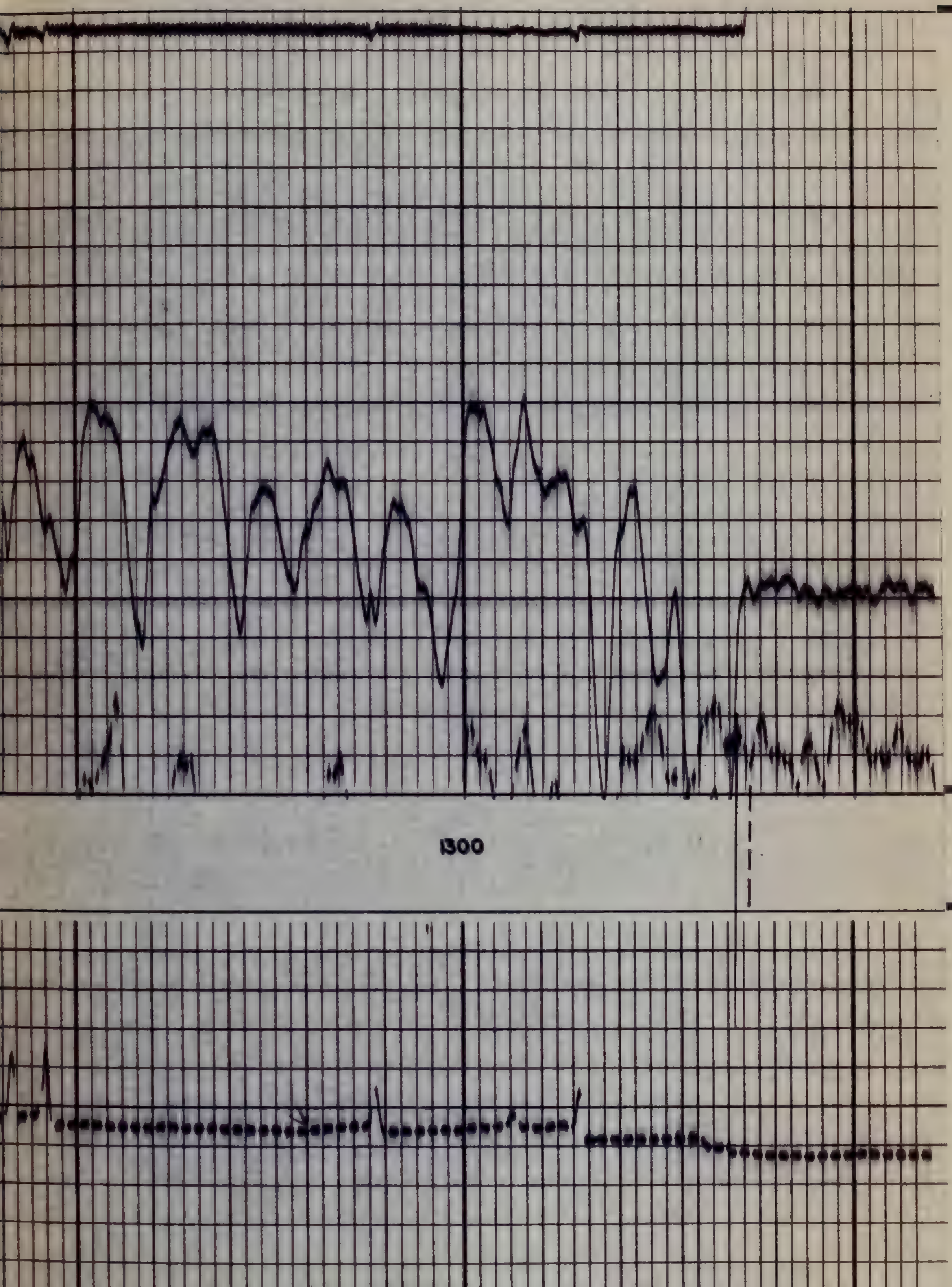

1300

INCREMENTAL WEIGHT LINE
INCREASES APPROX.
500#/DIV.

0 150
150 300

30 20 10 0 −10

GAMMA RAY
API UNITS

NEUTRON POROSITY INDEX %
SANDSTONE MATRIX

8 18

30 20 10 0 −10

CALIPER
HOLE DIAM. IN INCHES

DEPTHS

DENSITY POROSITY INDEX %
SANDSTONE MATRIX

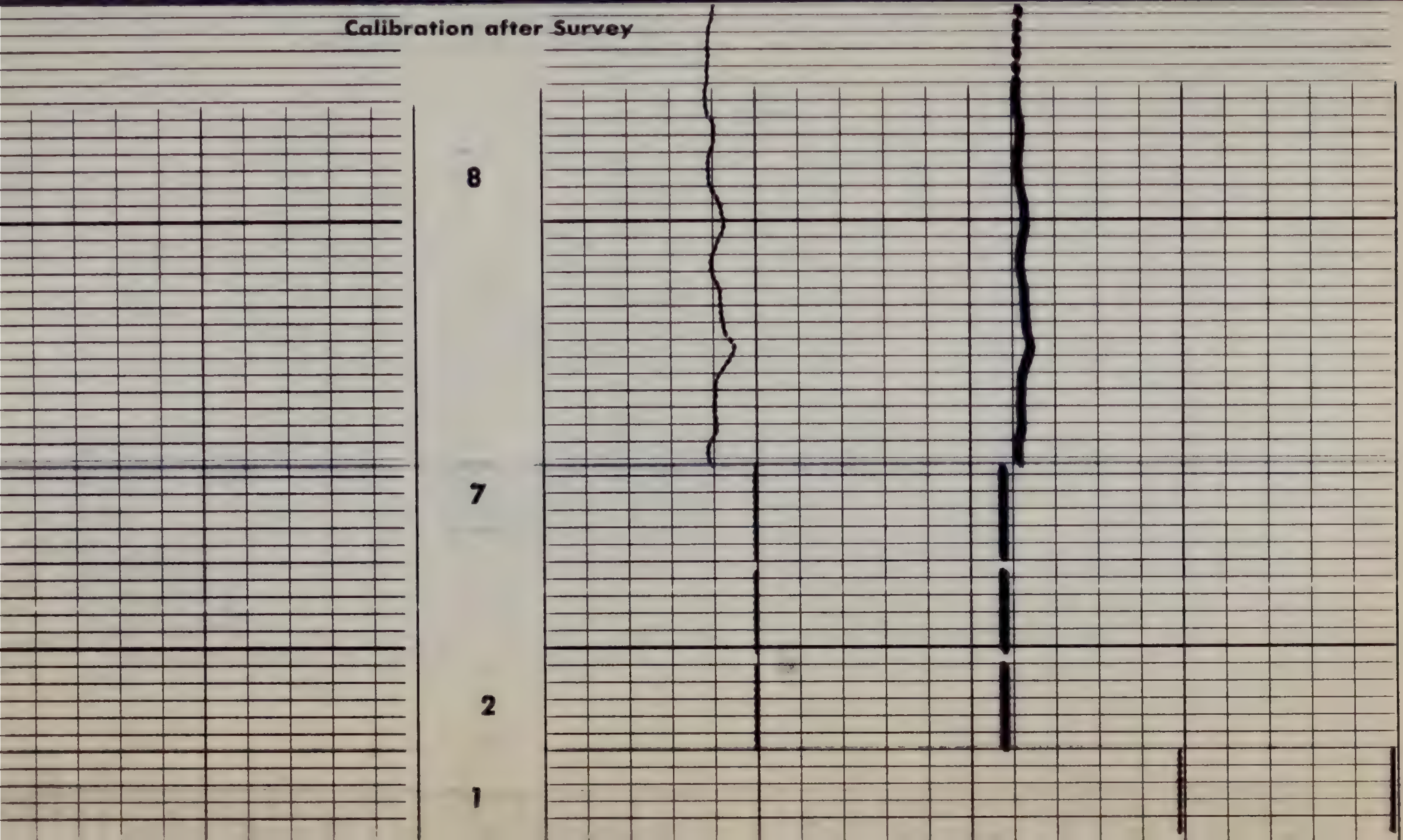
COMPANY ATLANTIC RICHFIELD COMPANY
WELL SORGUM GULCH AQUIFER NO. 1
FIELD
COUNTY RIO BLANCO STATE COLORADO

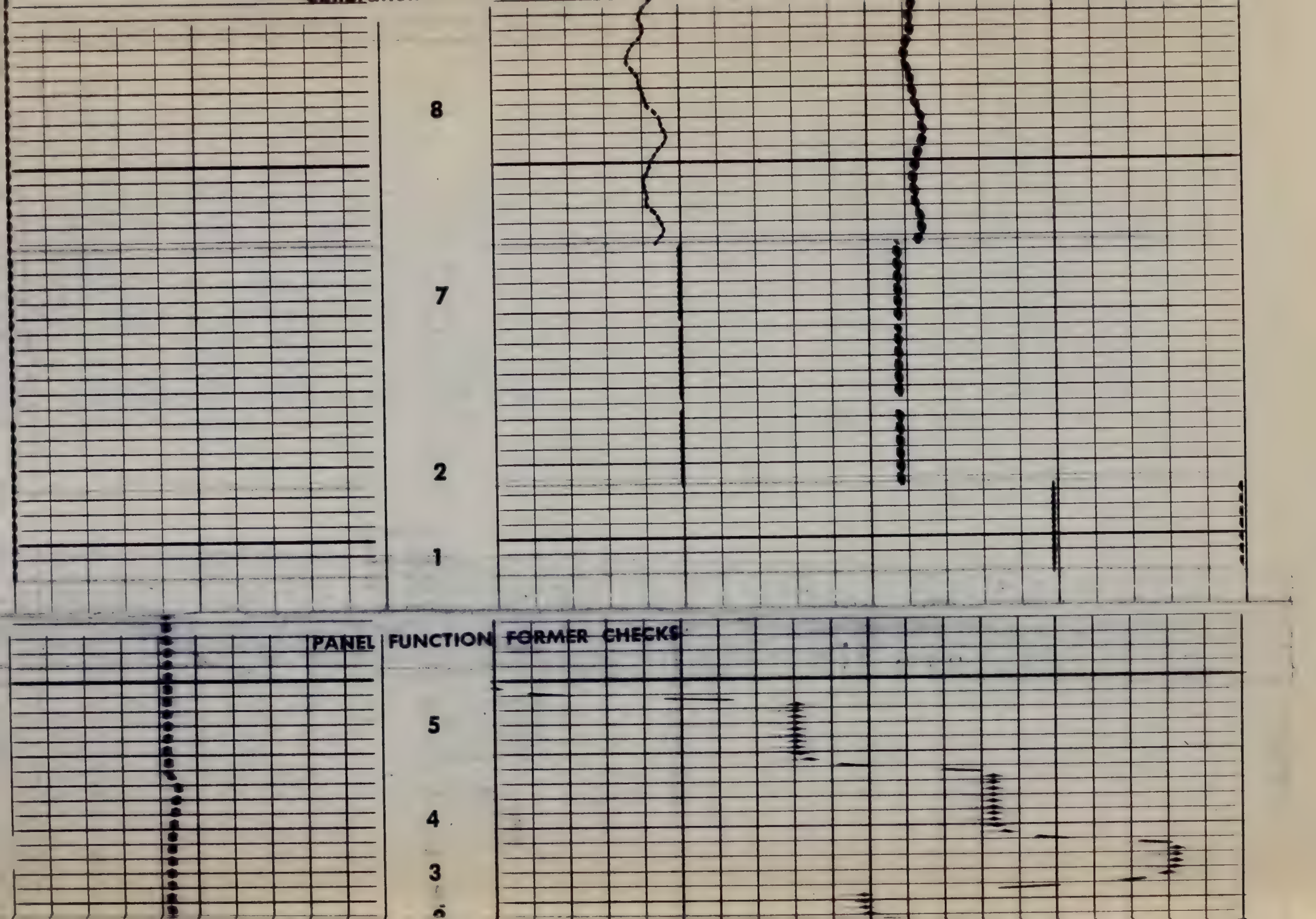
SCHL. FR 1337
SCHL. TD 1339
DRLR TD 1338
Elev:
KB -----
DF ----
GL 6909

CALIBRATION RECORD

COUNTY RIO BLANCO STATE COLORADO GL . 6909

CALIBRATION RECORD




8
7
2
1
PANEL FUNCTION FORMER CHECKS
5
4
3

COMPENSATED NEUTRON CALIBRATION CODING

1. MECHANICAL ZERO
2. RECORDED SENSITIVITY (THRU MEMORIZER IF USED)

PANEL TEST

	RATIO	OH POROSITY			CH POROSITY	
		LS ☐	SS ☐	DOL ☐	SS ☐	LS ☐
3.	1	1.6	4.9	−0.2	2.4	0.1
4.	2	15.6	19.7	8.1	13.0	9.0
5.	3	31.3	36.0	25.2	29.1	24.1
6.	4	52.2	61.4	53.0	52.2	45.2

7. POROSITY NORMALIZED WITH CNB-A IN PLACE
   7A. TOOL IN NCT-B
8. LOG POSITION WITH CNB-A IN PLACE
   8A. LOG POSITION WITH TOOL IN NCT-B

OH			CH	
LS	SS	DOL	SS	LS
18	22.2	10.4	15.3	11.2

RATIO (NORMALIZED) $= \frac{2.17}{\text{RATIO (NCT-B)}}$ RATIO LOG

FORMATION DENSITY COMPENSATED CALIBRATION CODING

1. MECHANICAL ZERO
2. RECORDER SENSITIVITY

PANEL TEST

FDC LIQUID

	POS	ρ	$\Delta\rho$
3.	# 1	2.92	.00
4.	# 2	2.78	+.14
5.	# 3	2.42	−.10
6.	# 4	2.35	.00
7.	# 5	2.08	.01

8. MECHANICAL ZERO CALIPER

9. 8″ RING
10. 12″ RING
11. TOOL CALIBRATE #1 SET $\rho = 2.50$
12. TOOL CALIBRATE #2 SET $\Delta\rho = .00$
13. LOG POSITION $\rho = 2.59$, $\Delta\rho = .015$

CALIBRATION RECORD

COMPANY ATLANTIC RICHFIELD COMPANY

WELL SORGUM GULCH AQUIFER NO. 1

FIELD

COUNTY RIO BLANCO STATE COLORADO

SCHL. FR 1337
SCHL. TD 1339
DRLR TD 1338
Elev:
KB ----
DF ----
GL 6909

SWS–1874-B

Schlumberger

TEMPERATURE LOG

COUNTY RIO BLANCO
FIELD or LOCATION SORGUM GULCH
WELL AQUIFER NO. 1
COMPANY ATLANTIC RICHFIEL

COMPANY ATLANTIC RICHFIELD COMPANY

WELL SORGUM GULCH AQUIFER NO. 1

FIELD

COUNTY RIO BLANCO STATE COLORADO

LOCATION

Sec. 7 Twp. 3S Rge. 96W

Other Services:
DIL BHC-GR
FDC-GR
CNL-GR

Permanent Datum: GL ; Elev.: 6909
Log Measured From GL , 0 Ft. Above Perm. Datum
Drilling Measured From GL

Elev.: K.B. ----
D.F. ----
G.L. 6909

Date	7-5-74		
Run No.	ONE		
Depth—Driller	1338		
Depth—Logger	1340		
Btm. Log Interval	1338		
Top Log Interval	350		
Casing—Driller	13-3/8 @ 166	@	@
Casing—Logger	----		
Casing Size 1	To	To	To
2	To	To	To
Casing Weight 1			
2			
Casing Thickness 1			
2			
Bit Size 1	12-1/4 To	To	To
2	To	To	To
Type Fluid in Hole	WATER		
Dens. | Visc.			
Time Since Circ.			
BHT			
Equip. | Location	7674 | VERNAL		
Recorded By	HAUGAARD		
Witnessed By	TATE		

The well name, location and borehole reference data were furnished by the customer.

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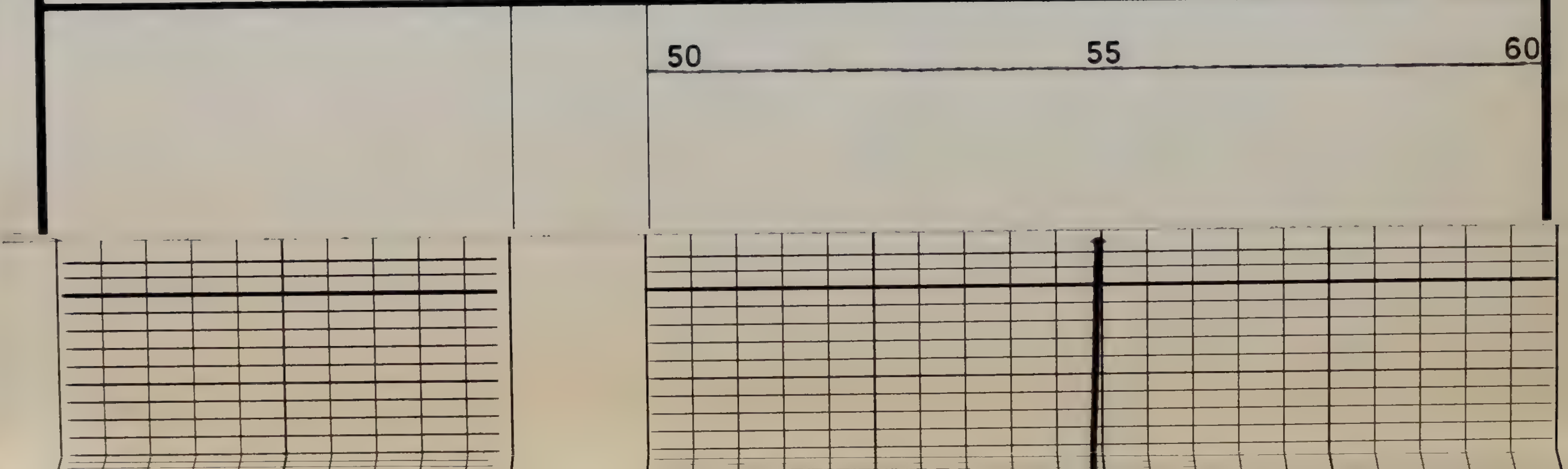
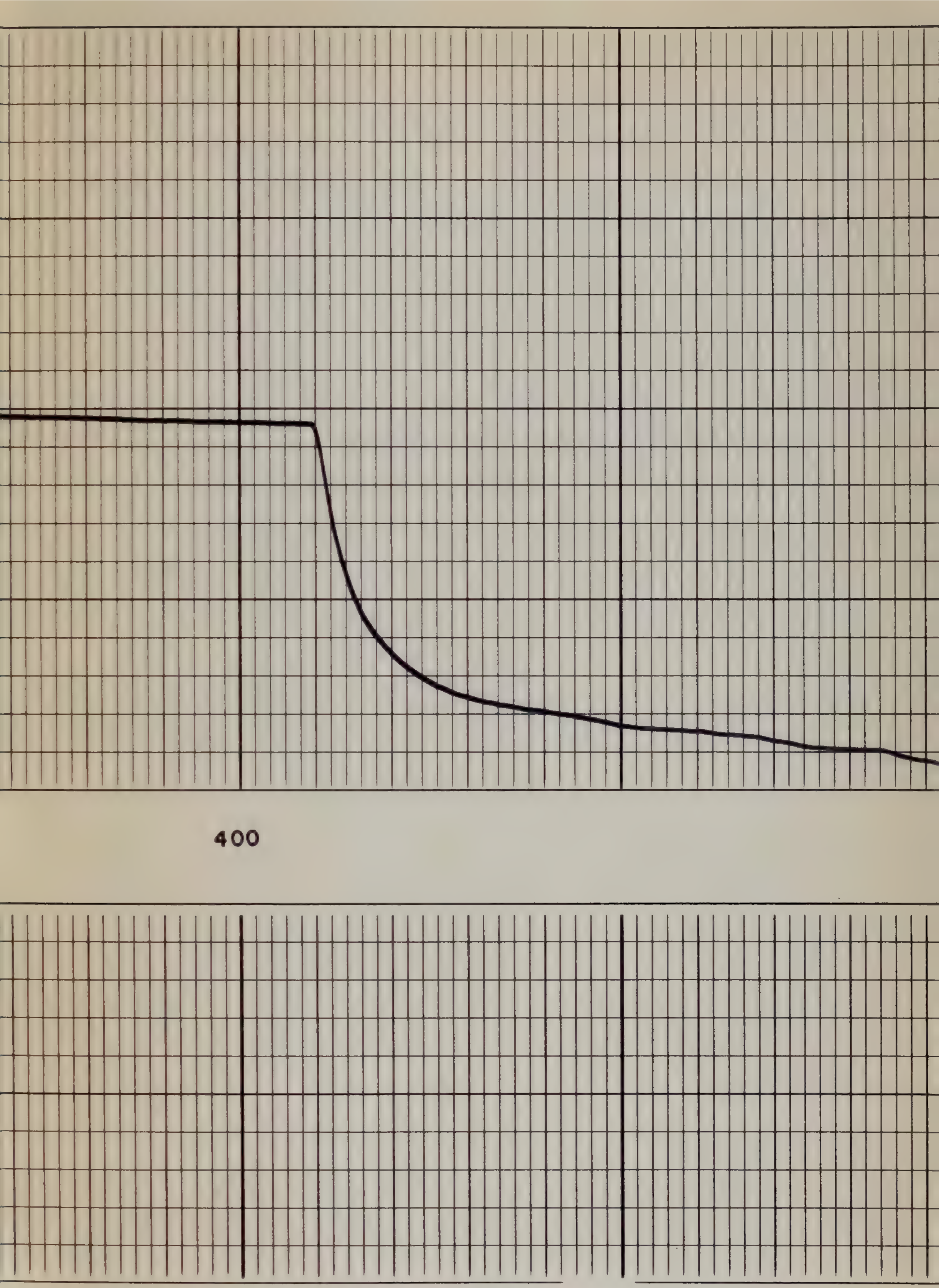
REMARKS: SO #07174

CEMENTATION DATA

Date	Depth	Type of Cement	Nb of Sacks	Additives	Calculated Top

TEMPERATURE °F.

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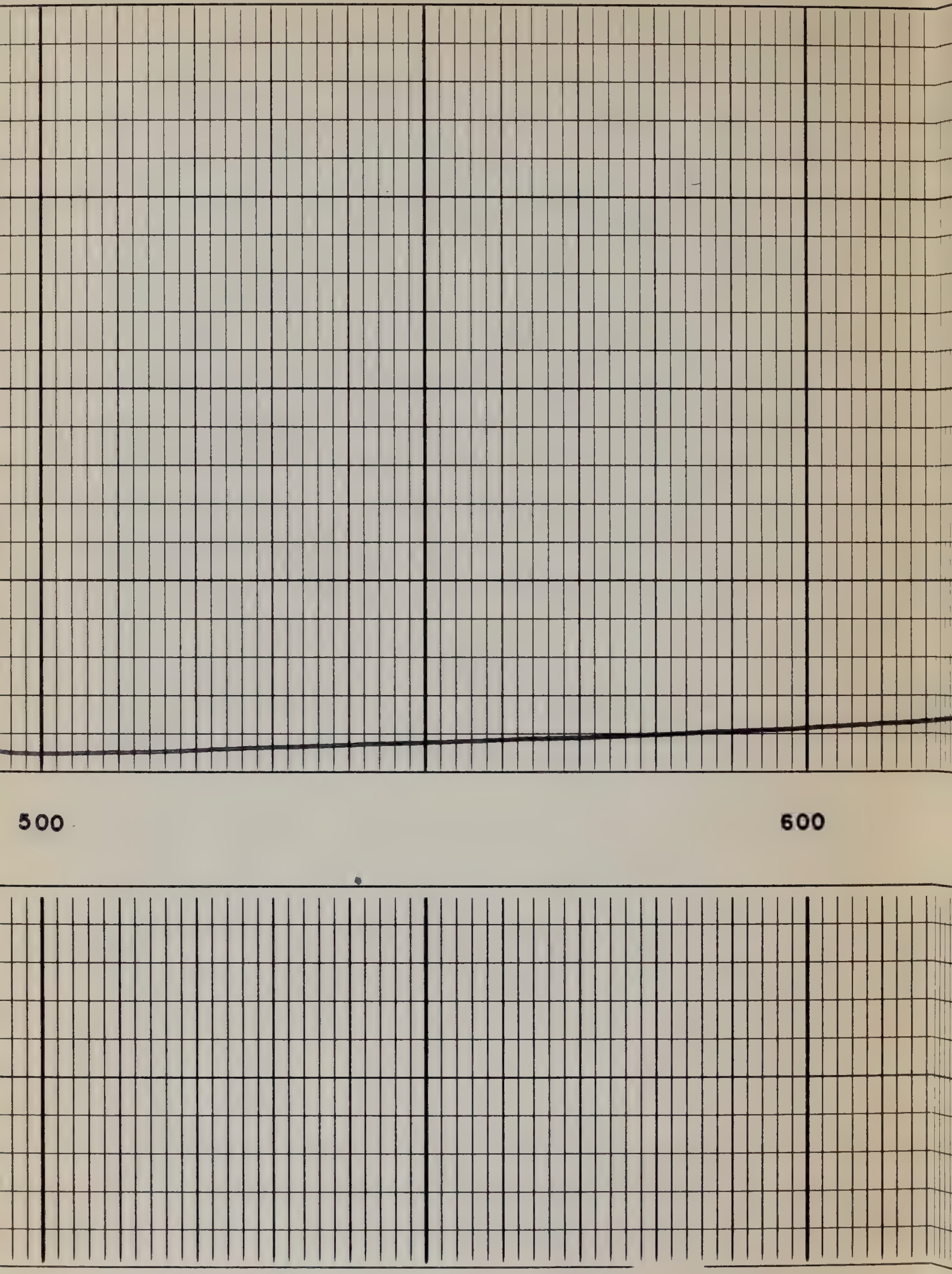
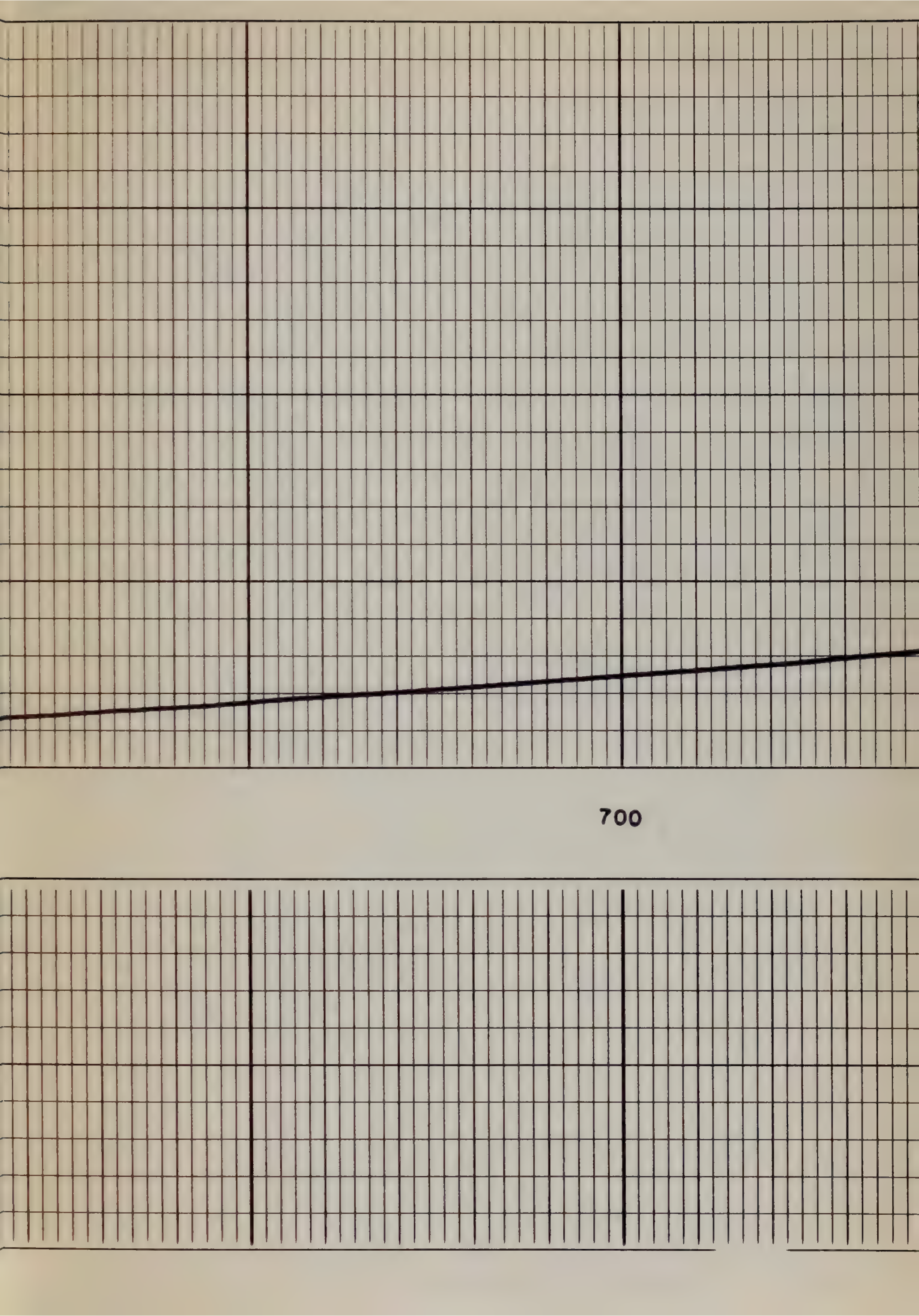

500
600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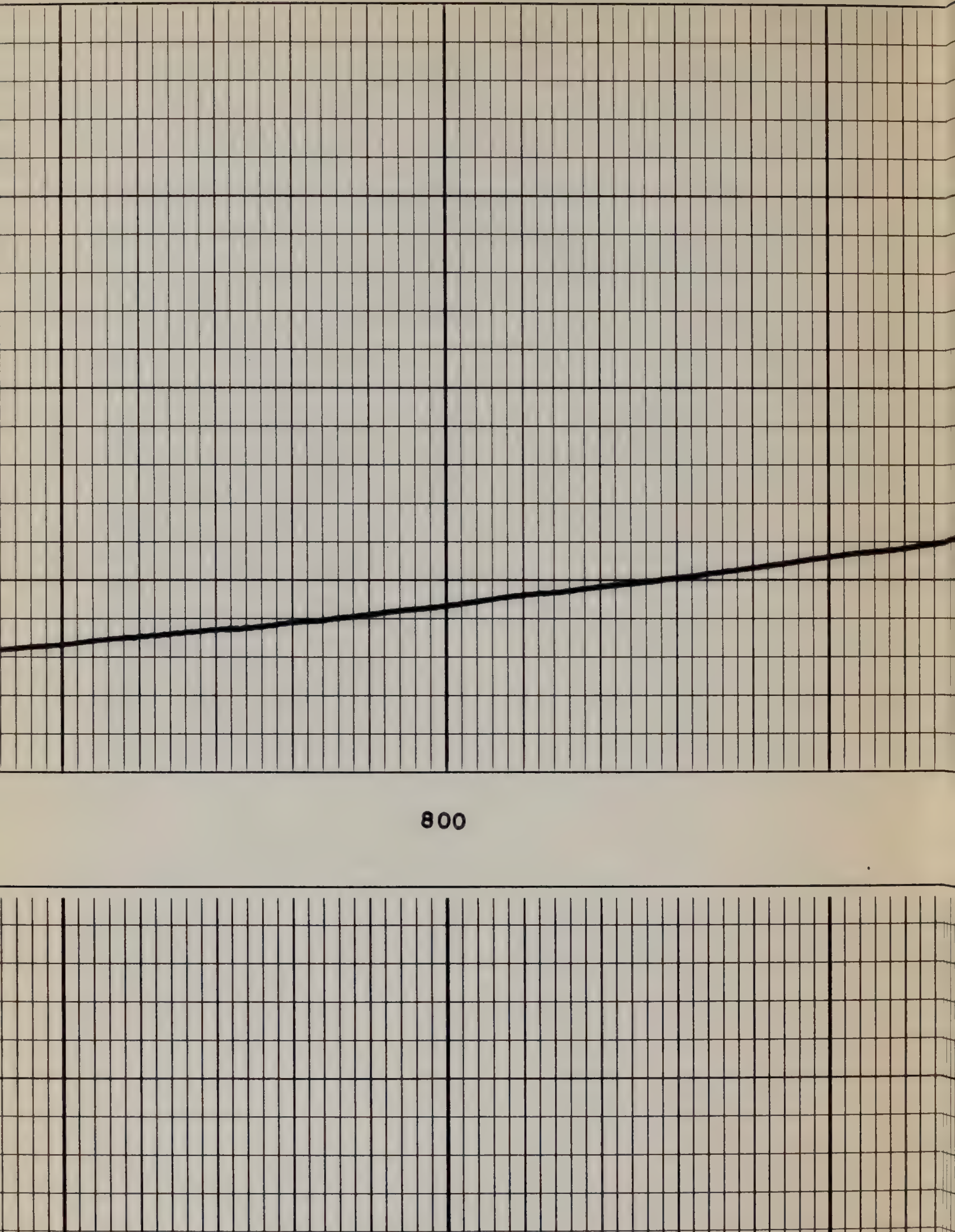
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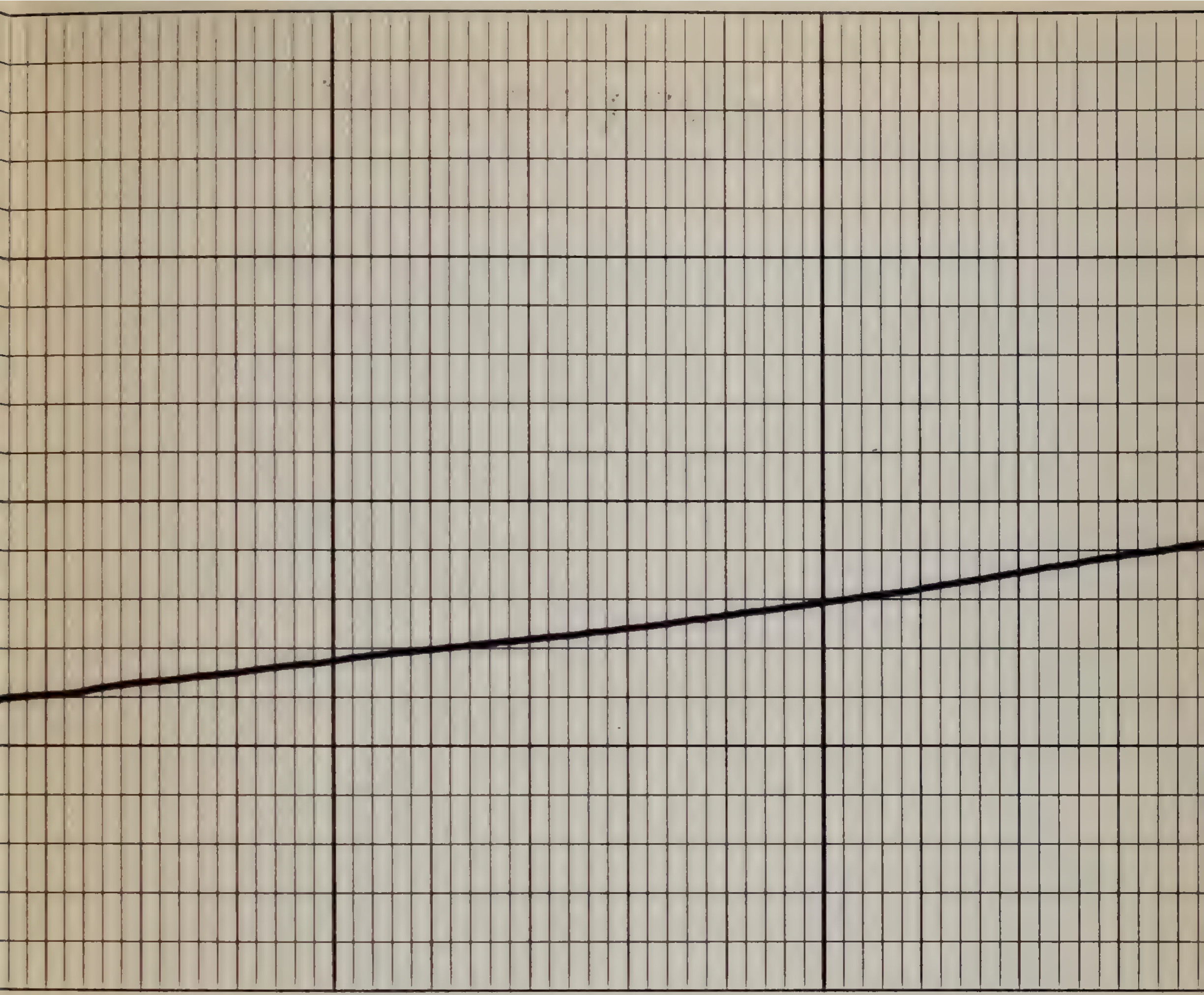

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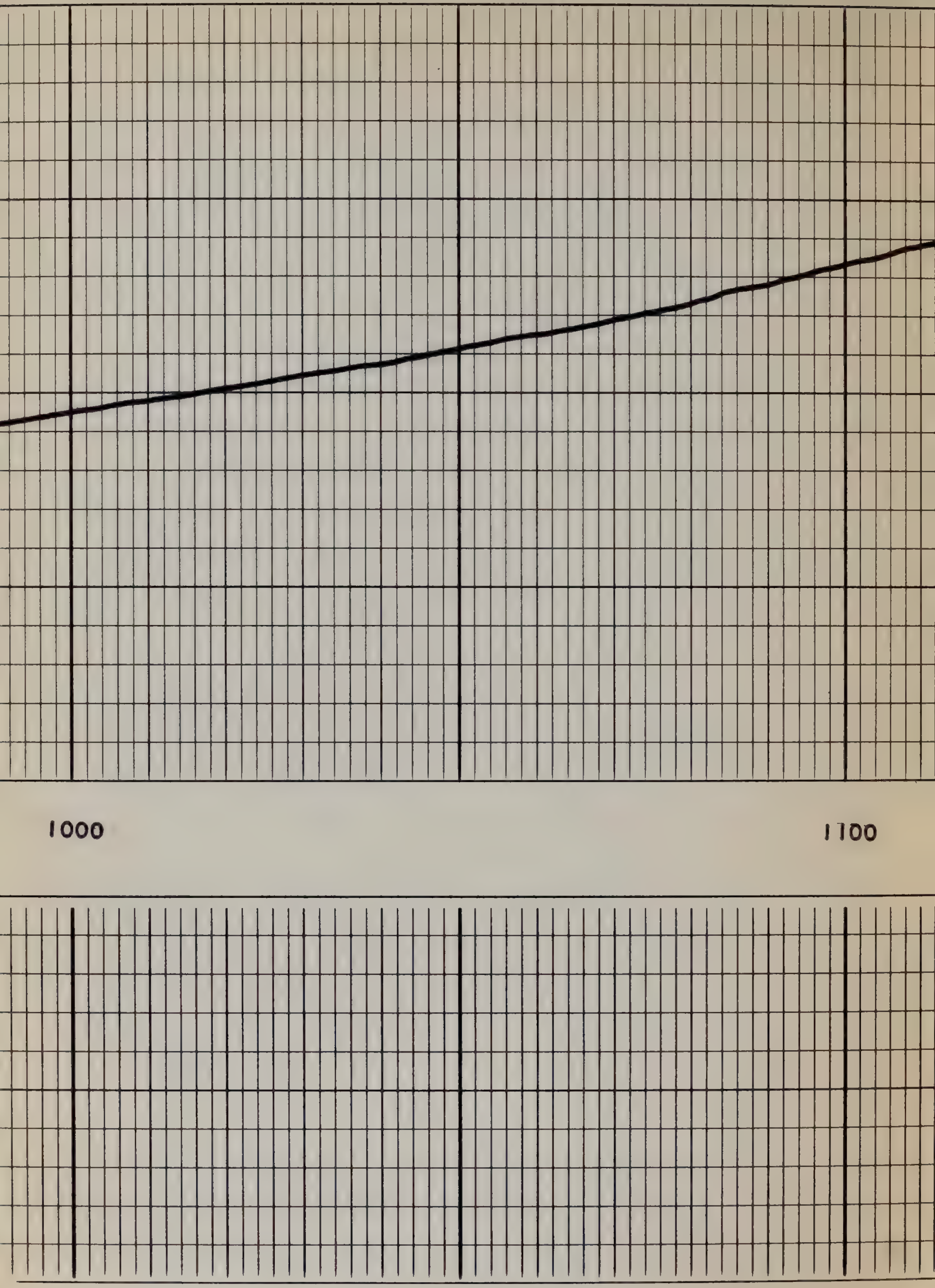
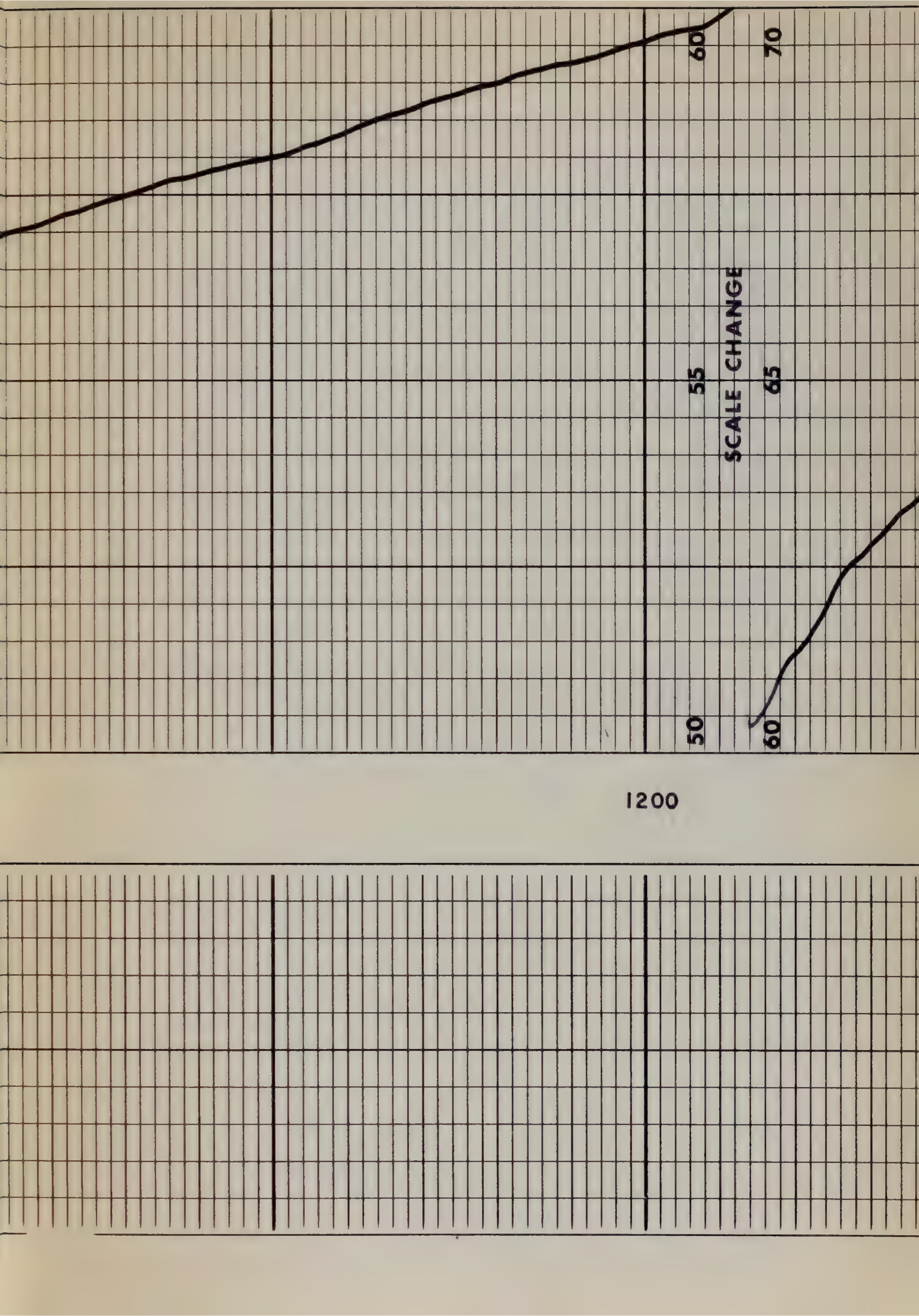
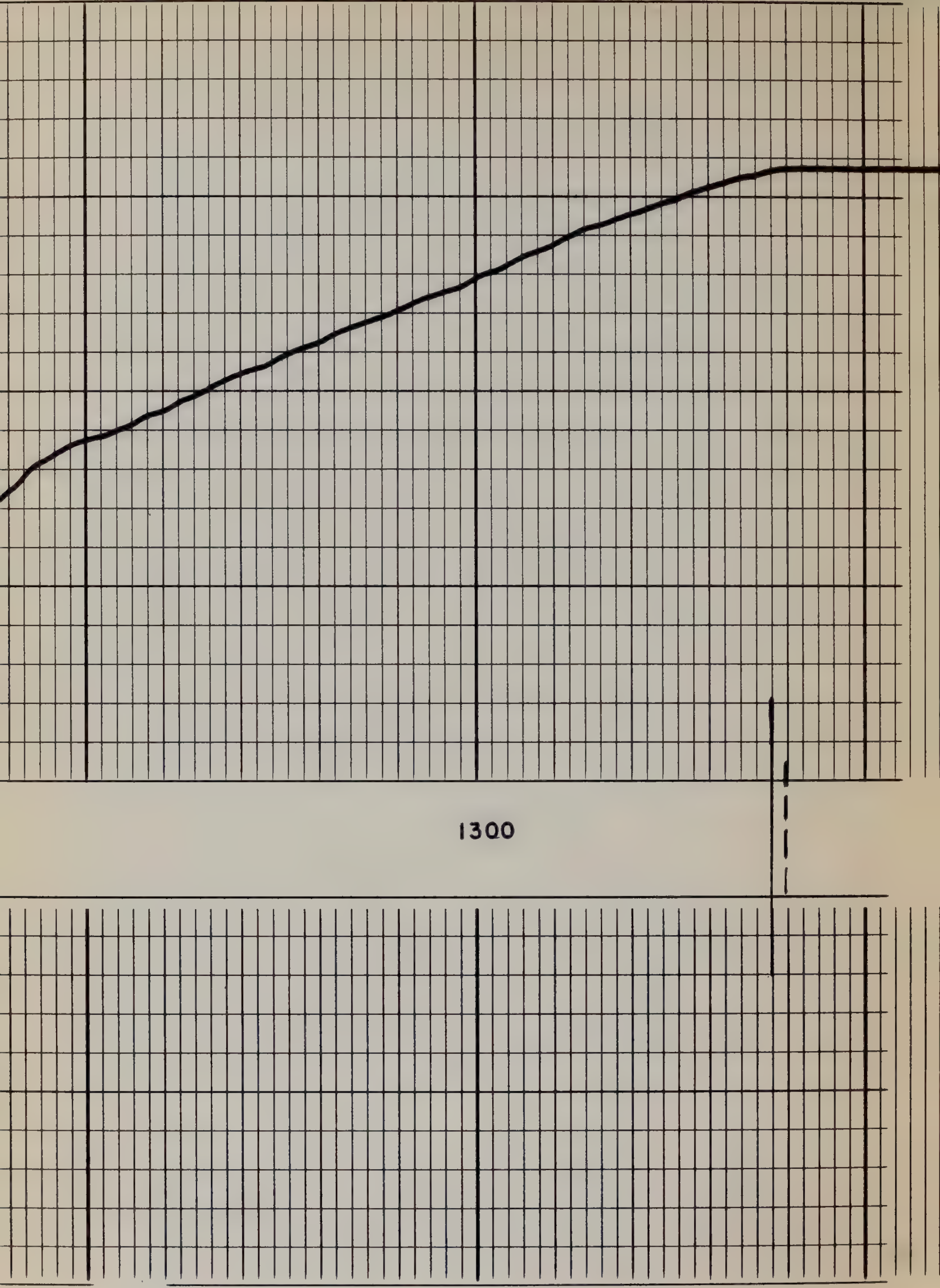

1000
1100


60
70
55
SCALE CHANGE
65
50
60
1200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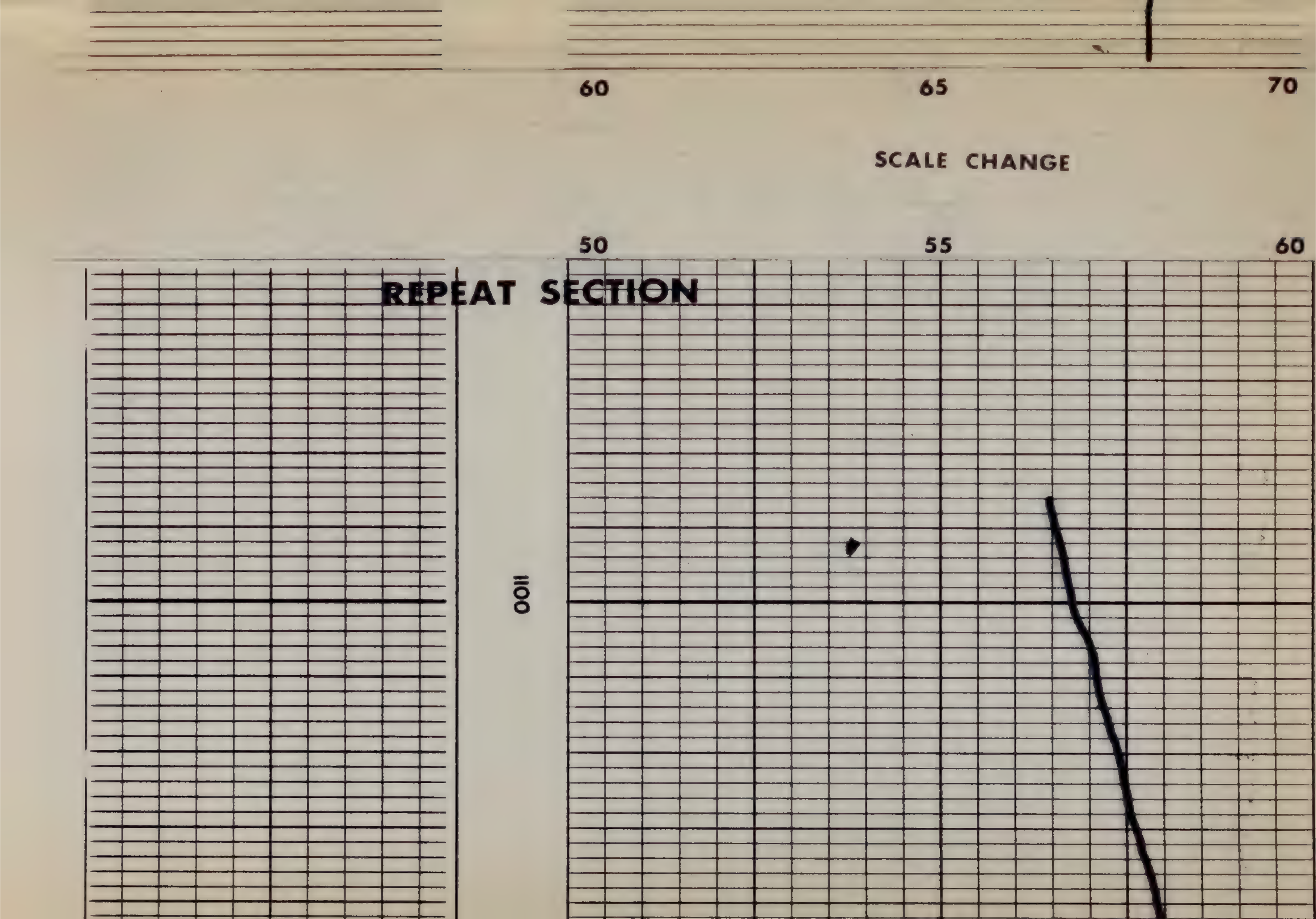

60
65
70
SCALE CHANGE
50
55
60
REPEAT SECTION
1100

60 65 70

TEMPERATURE °F.

COMPANY ATLANTIC RICHFIELD COMPANY

WELL SORGUM GULCH AQUIFER NO. 1

FIELD

COUNTY RIO BLANCO

STATE COLORADO

SCHL. F. R. 1338
SCHL. T. D. 1340
DRLR. T. D. 1338

Schlumberger

TEMPERATURE LOG

COUNTY RIO BLANCO
FIELD or LOCATION SORGUM GULCH
WELL AQUIFER #1-A
COMPANY ATLANTIC RICH.

COMPANY ATLANTIC RICHFIELD COMPANY

WELL SORGUM GULCH AQUIFER NO. 1-A

FIELD

COUNTY RIO BLANCO STATE COLORADO

LOCATION

Sec. 7 Twp. 3S Rge. 96W

Other Services:

Permanent Datum: GL ; Elev.: 6909
Log Measured From GL , 0 Ft. Above Perm. Datum
Drilling Measured From GL

Elev.: K.B. ----
D.F. ----
G.L. 6909

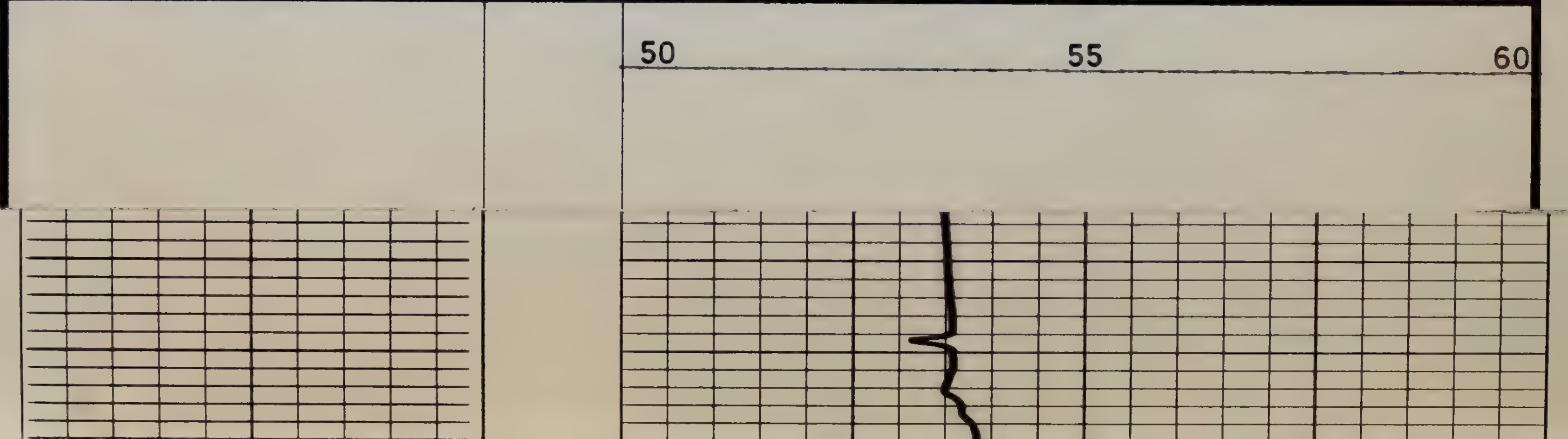
Date	7-6-74		
Run No.	ONE		
Depth—Driller	1620		
Depth—Logger	1620		
Btm. Log Interval	1618		
Top Log Interval	370		
Casing—Driller	7 @ 62	@	@
Casing—Logger	----		
Casing Size 1	To	To	To
2	To	To	To
Casing Weight 1			
2			
Casing Thickness 1			
2			
Bit Size 1	6-1/4 To	To	To
2	To	To	To
Type Fluid in Hole	WATER		
Dens. | Visc.			
Time Since Circ.			
BHT			
Equip. | Location	7674 VERNAL		
Recorded By	HAUGAARD		
Witnessed By	TATE		

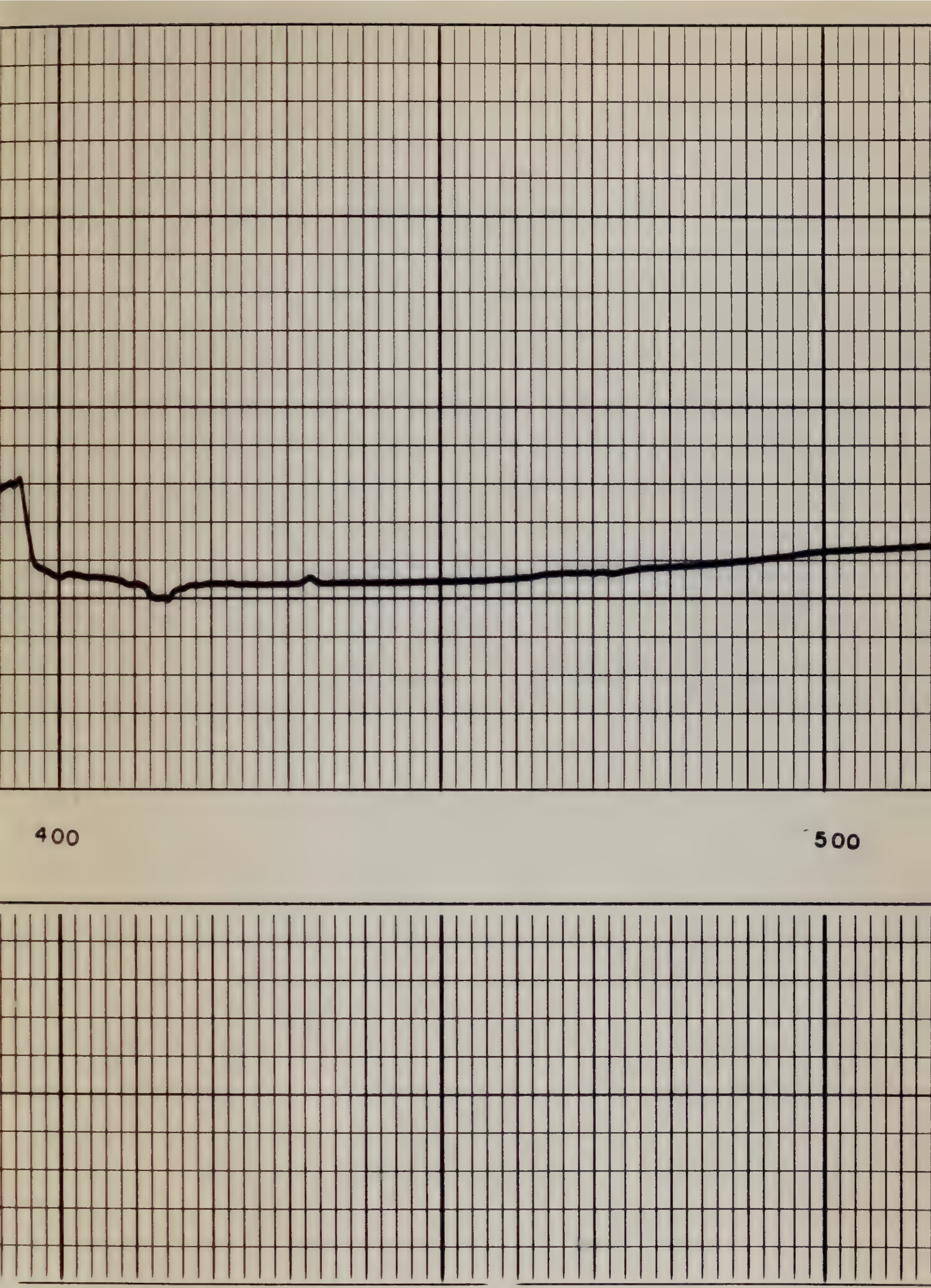
REMARKS: SO #07175

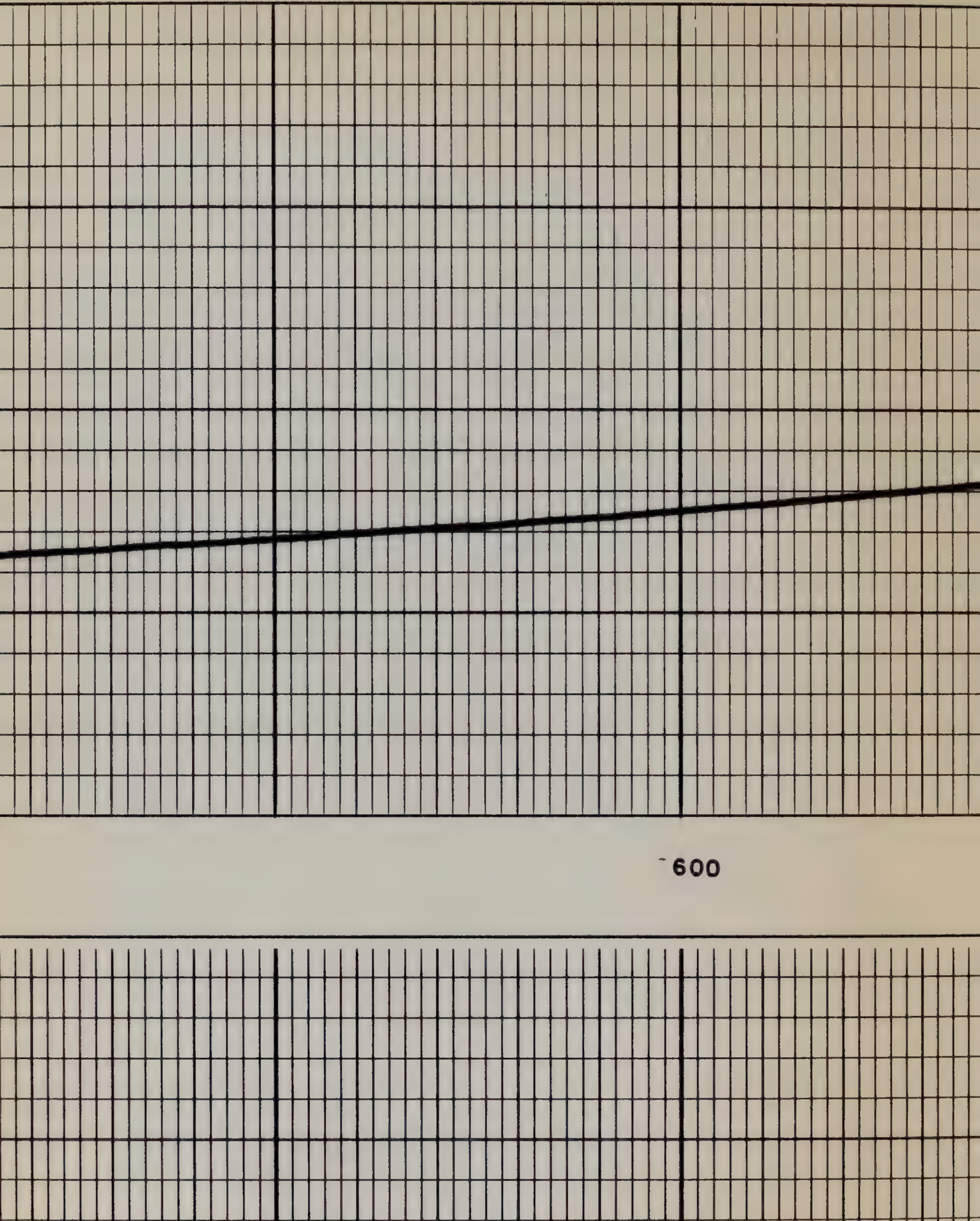
CEMENTATION DATA

Date	Depth	Type of Cement	Nb of Sacks	Additives	Calculated Top

TEMPERATURE °F.




400
500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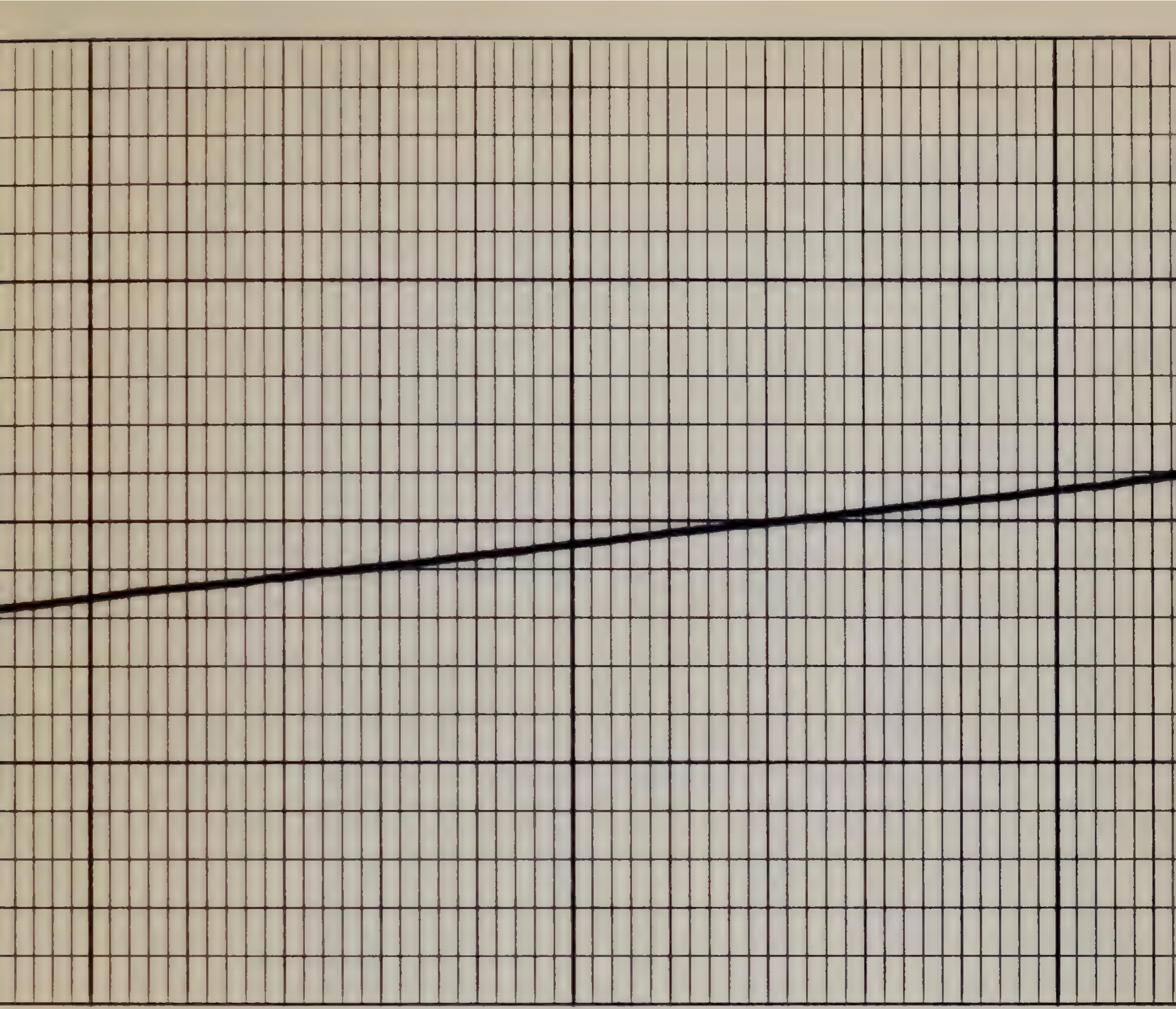

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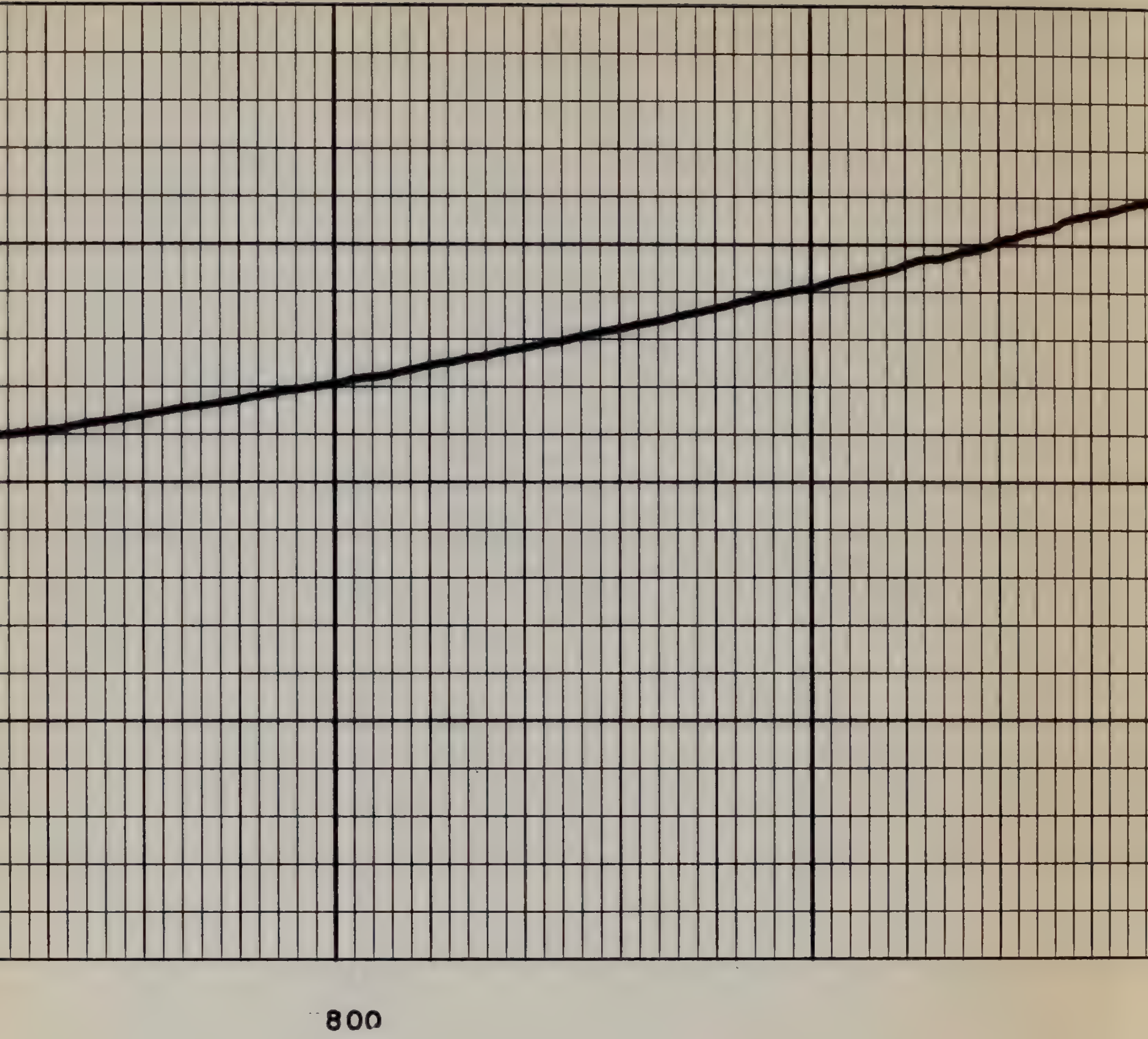
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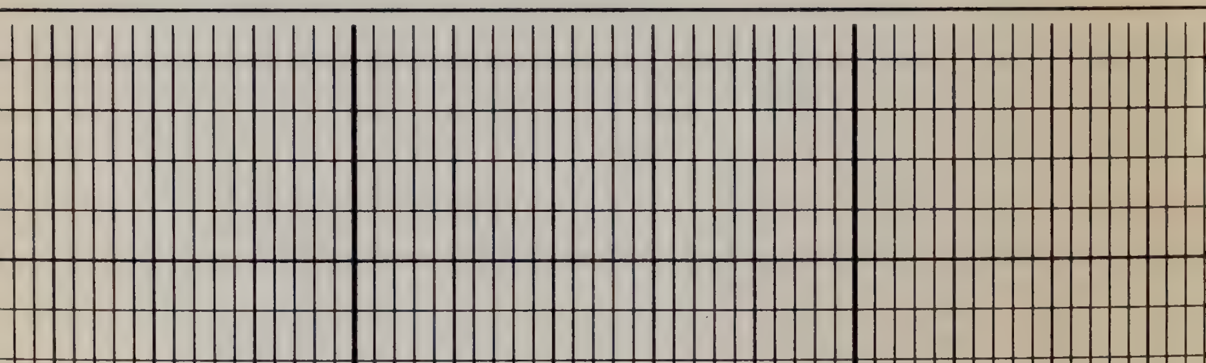
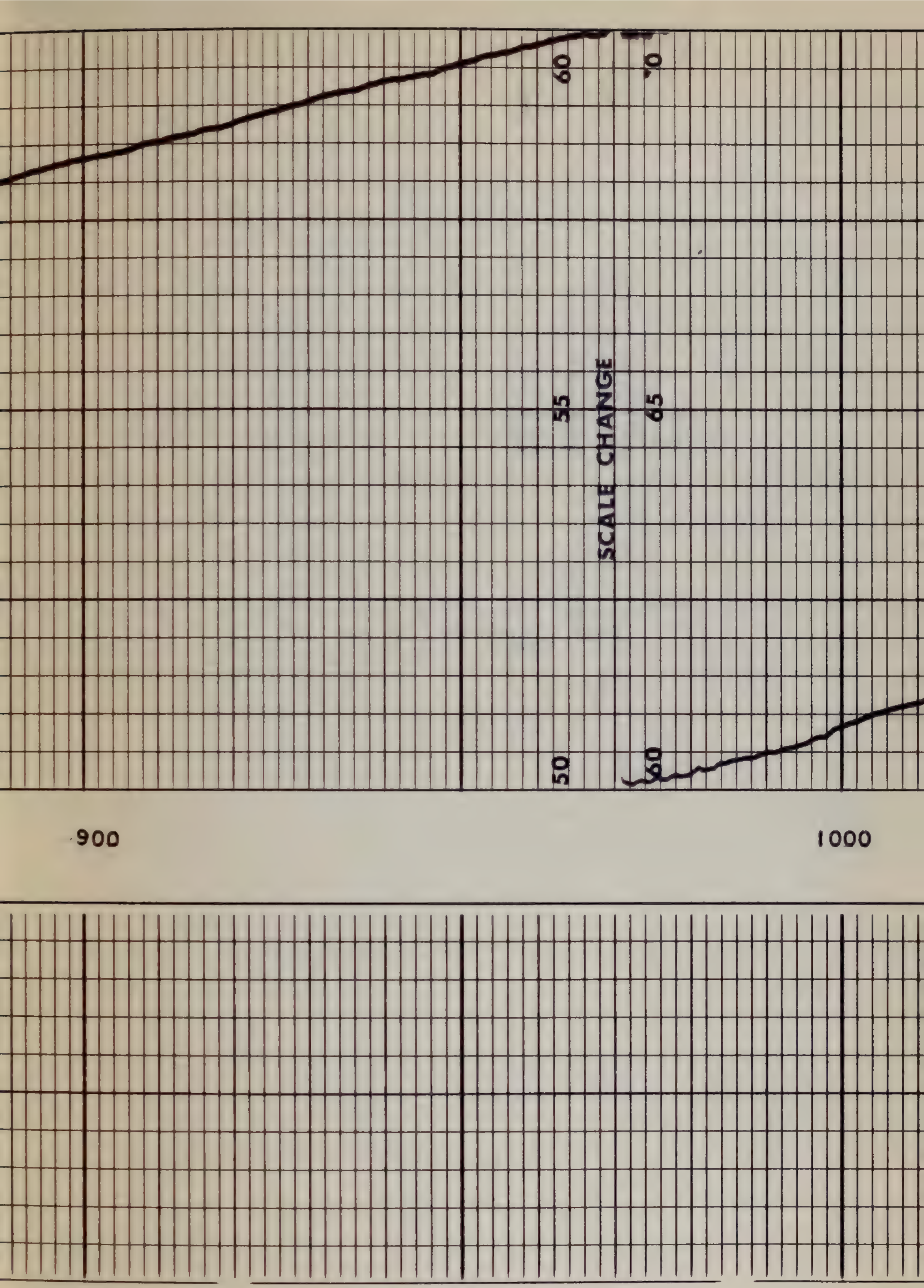
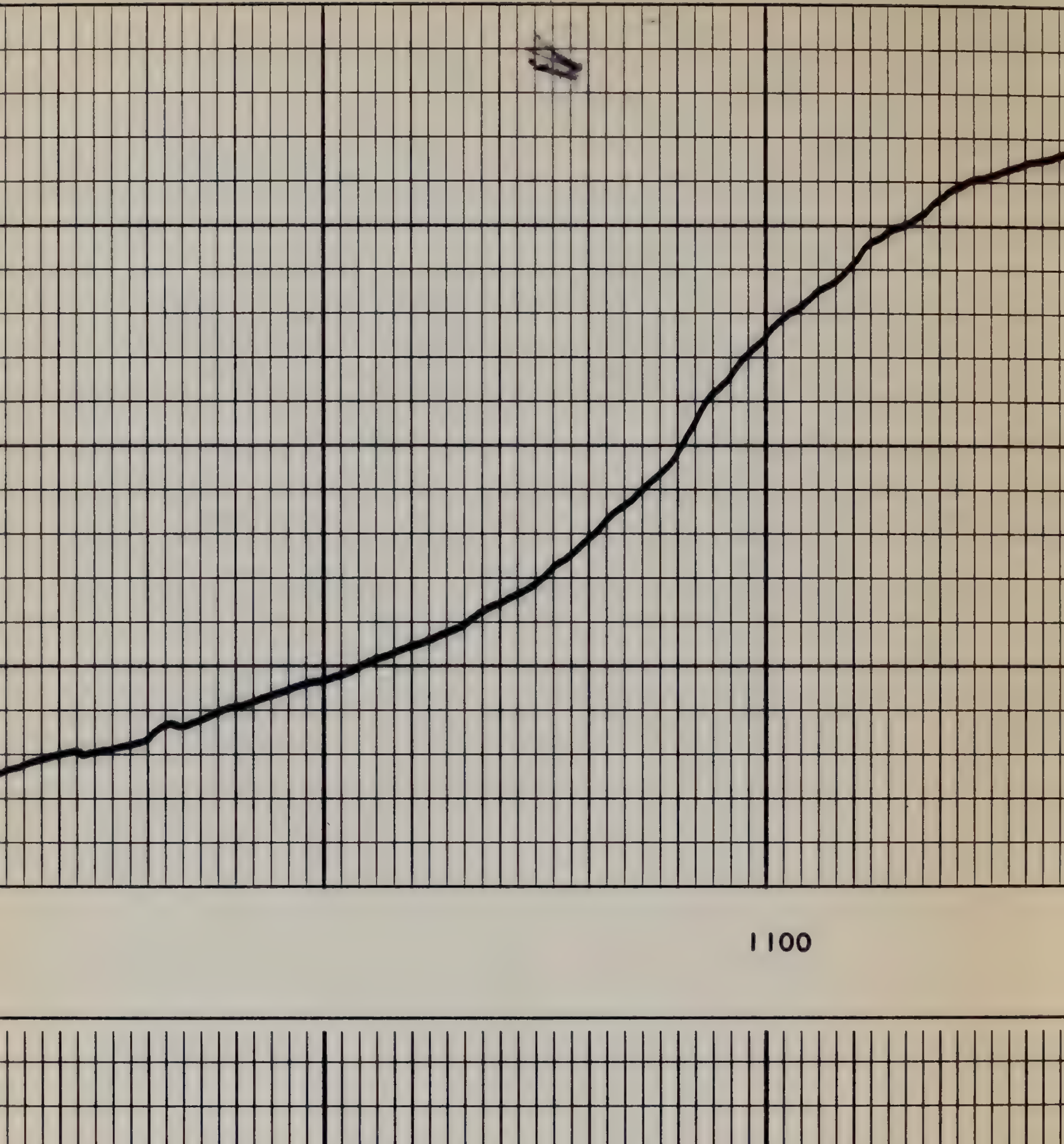
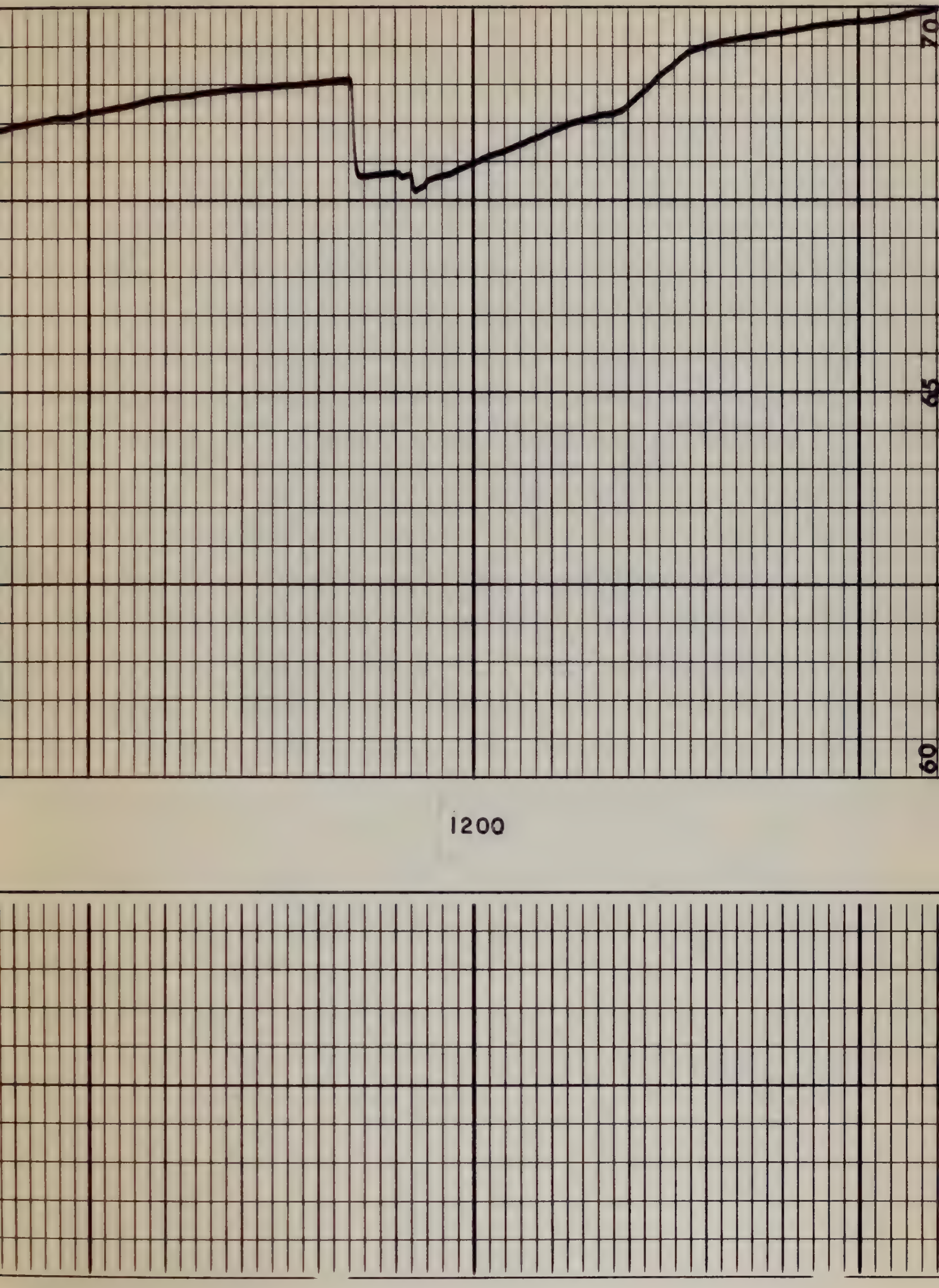
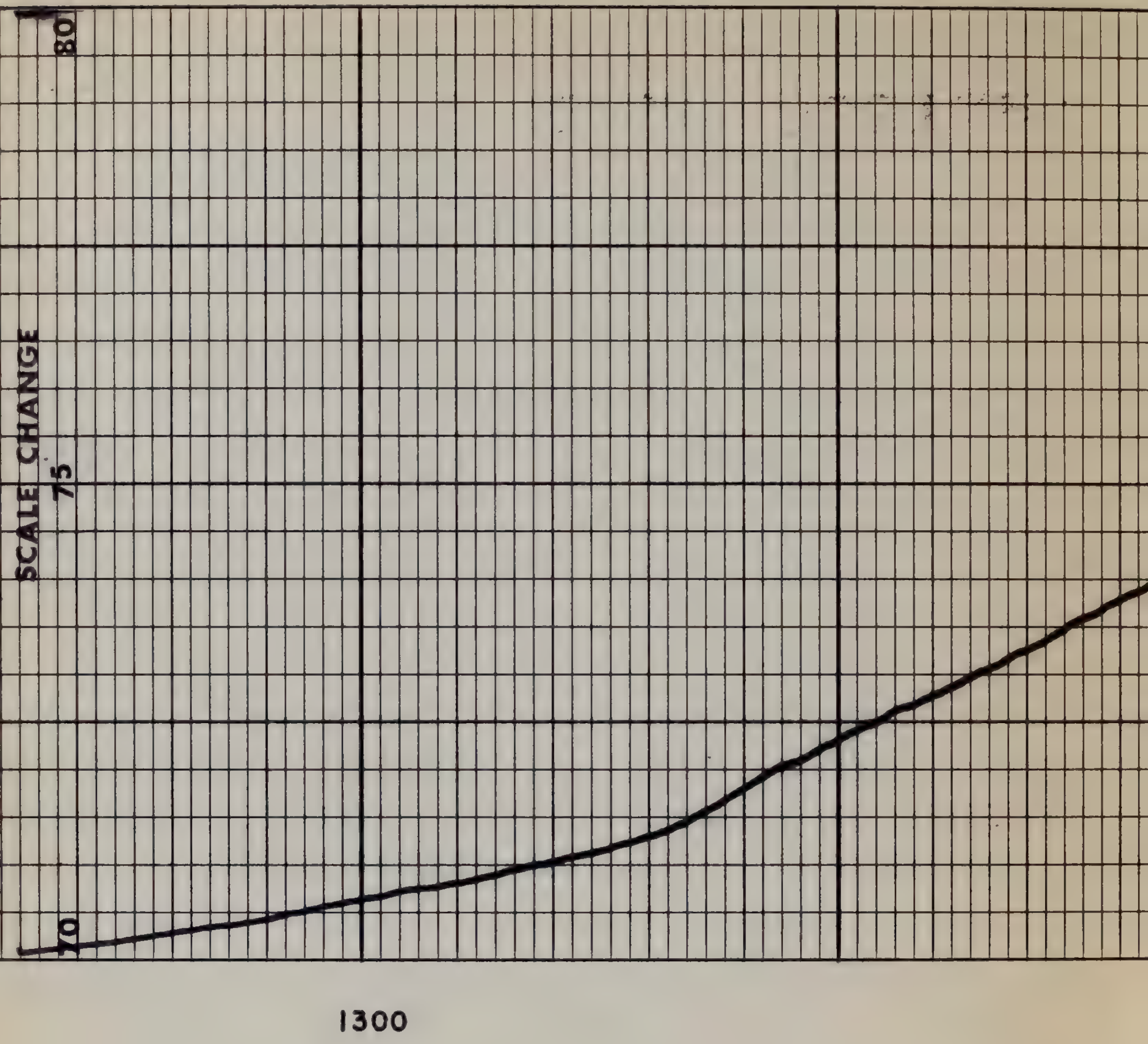
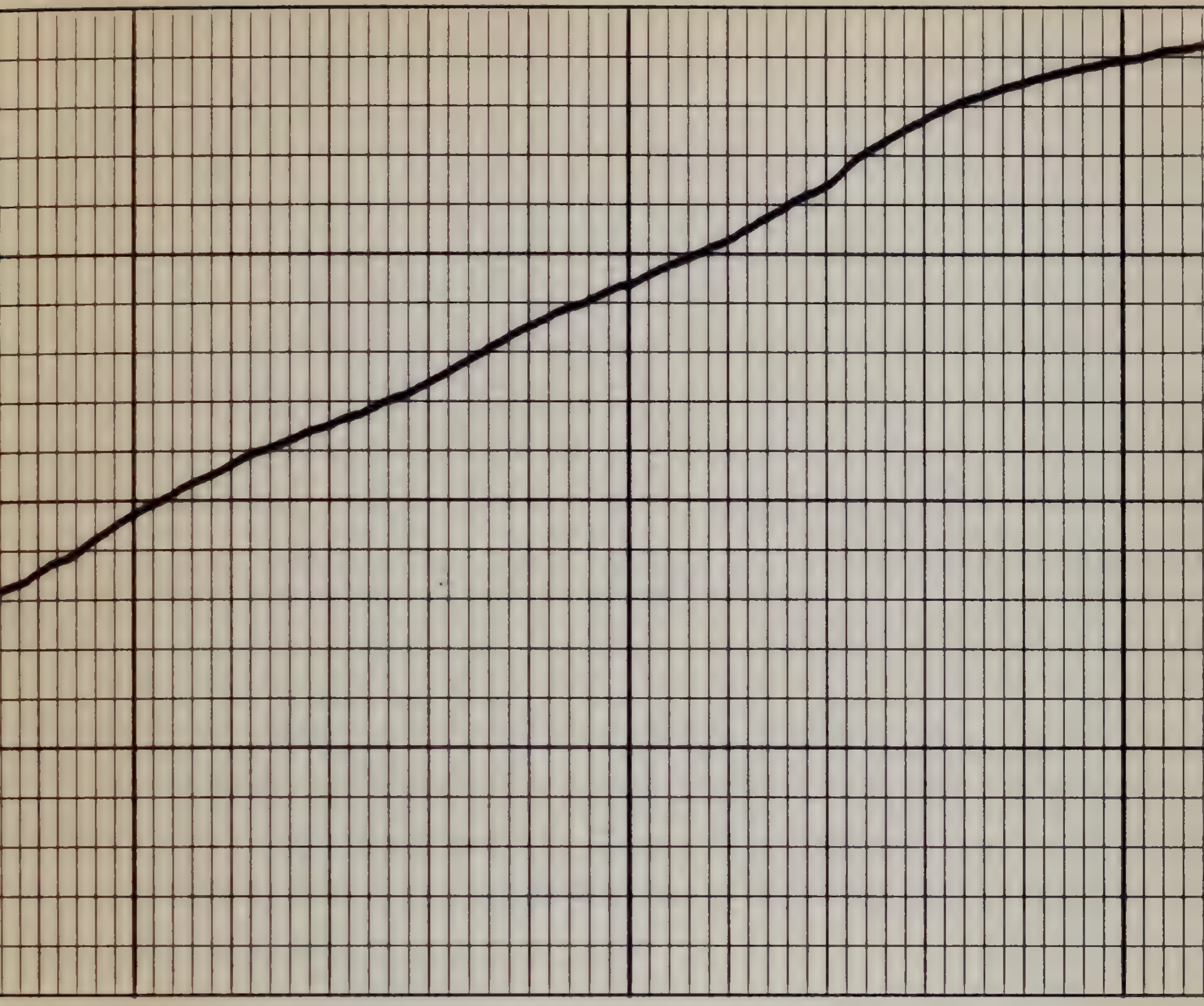


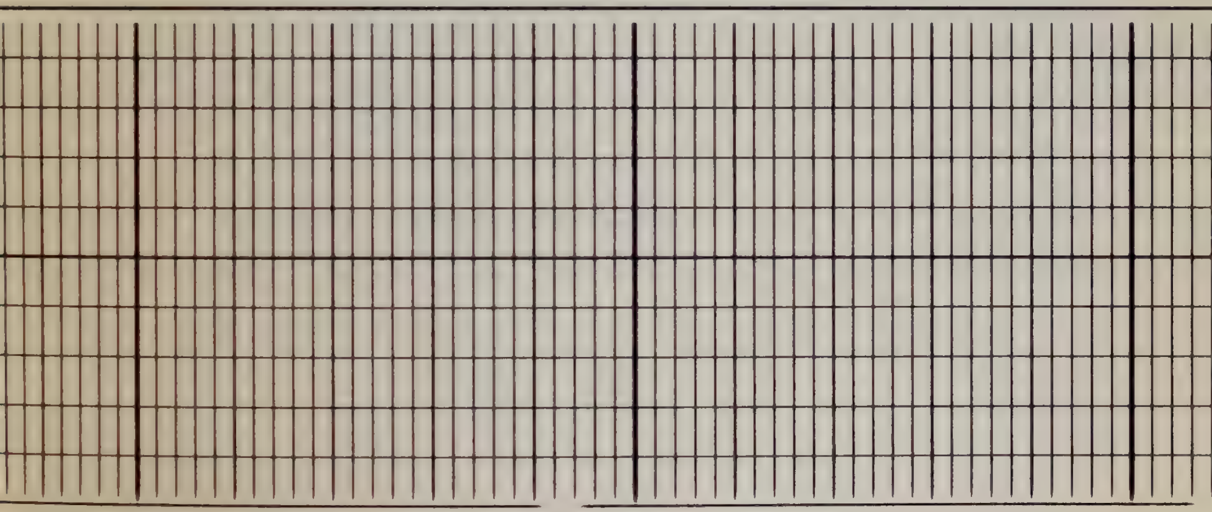

60
70
55
SCALE CHANGE
65
50
60
900
1000

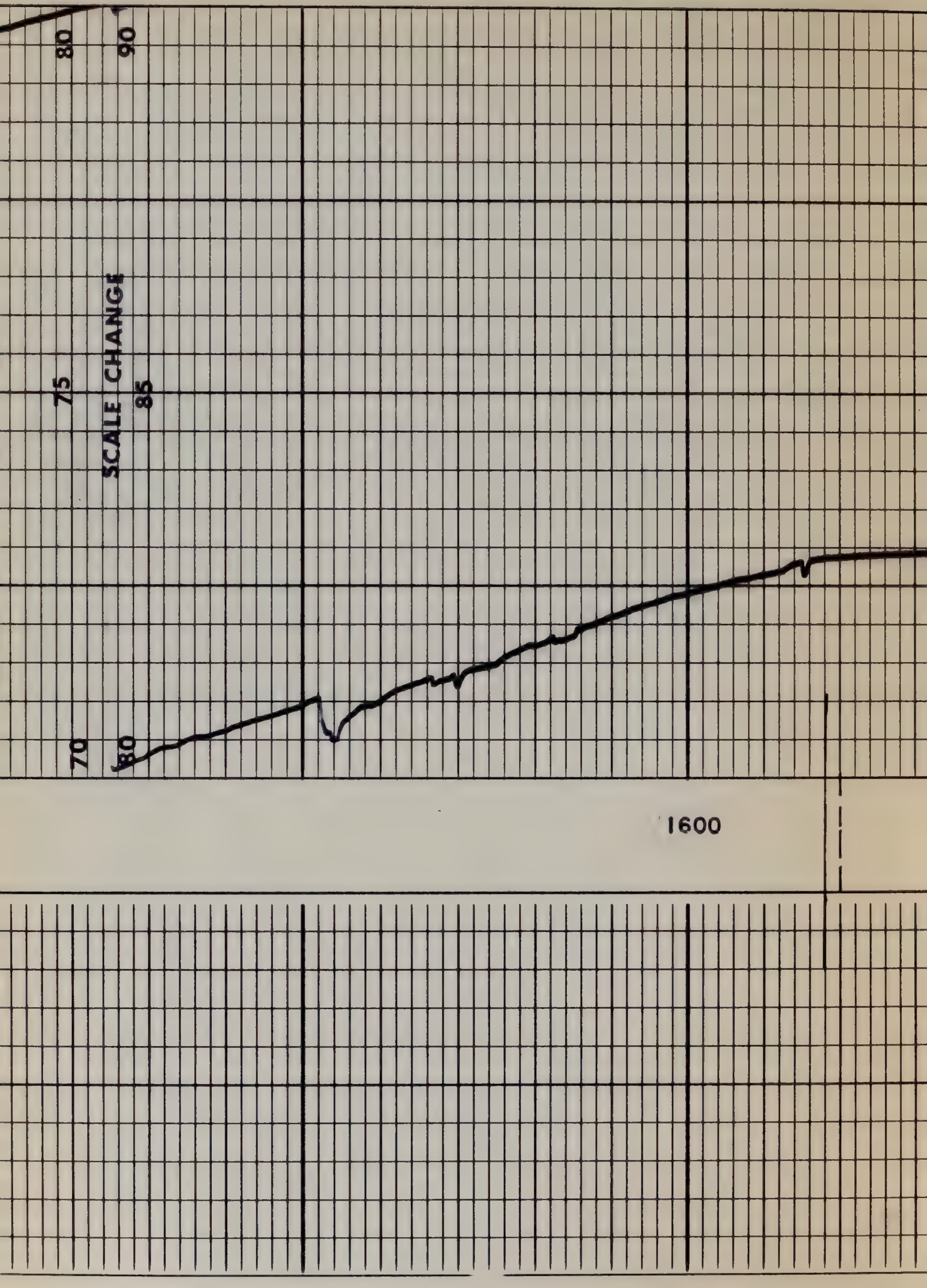

1100

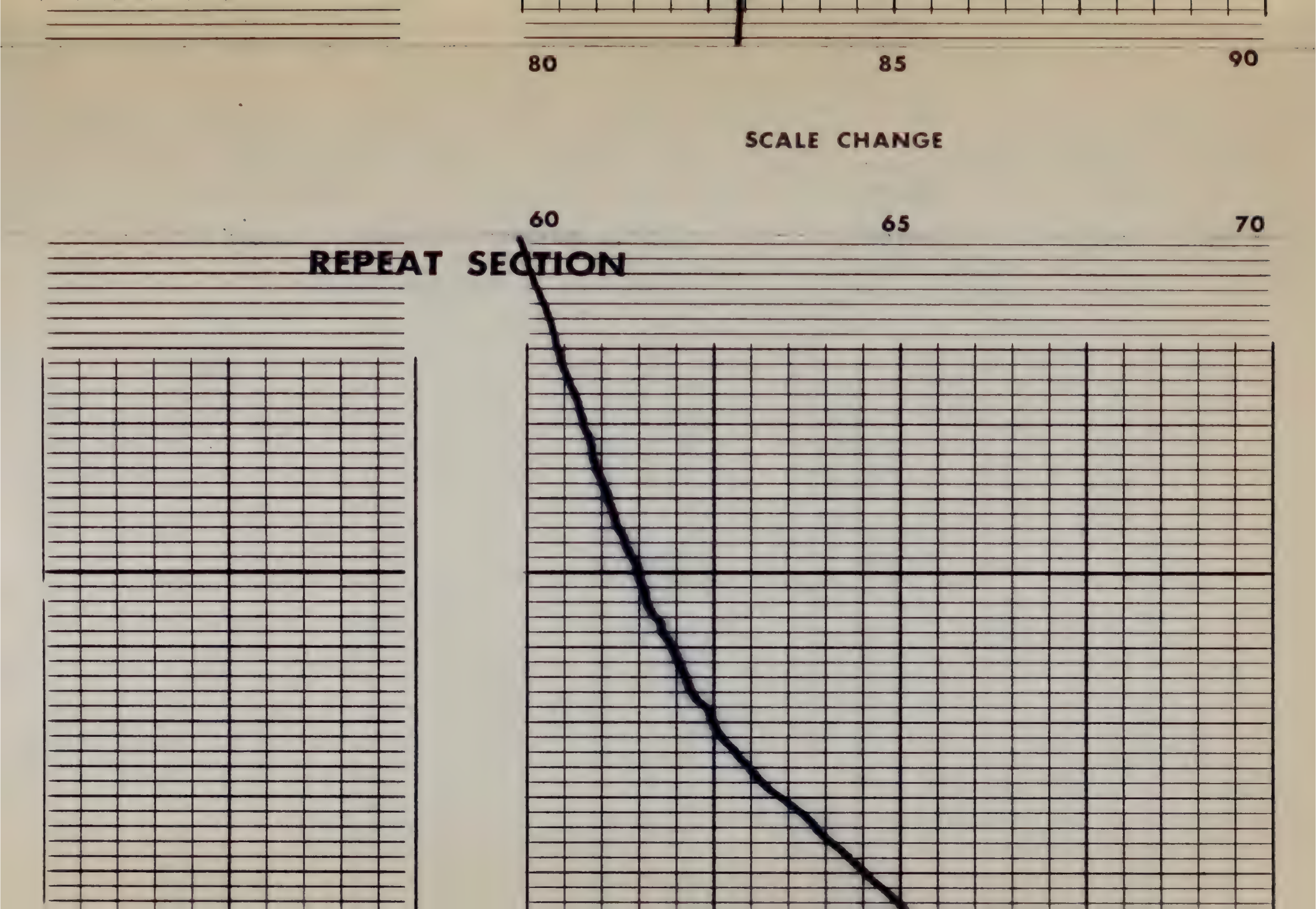

70
65
60
1200

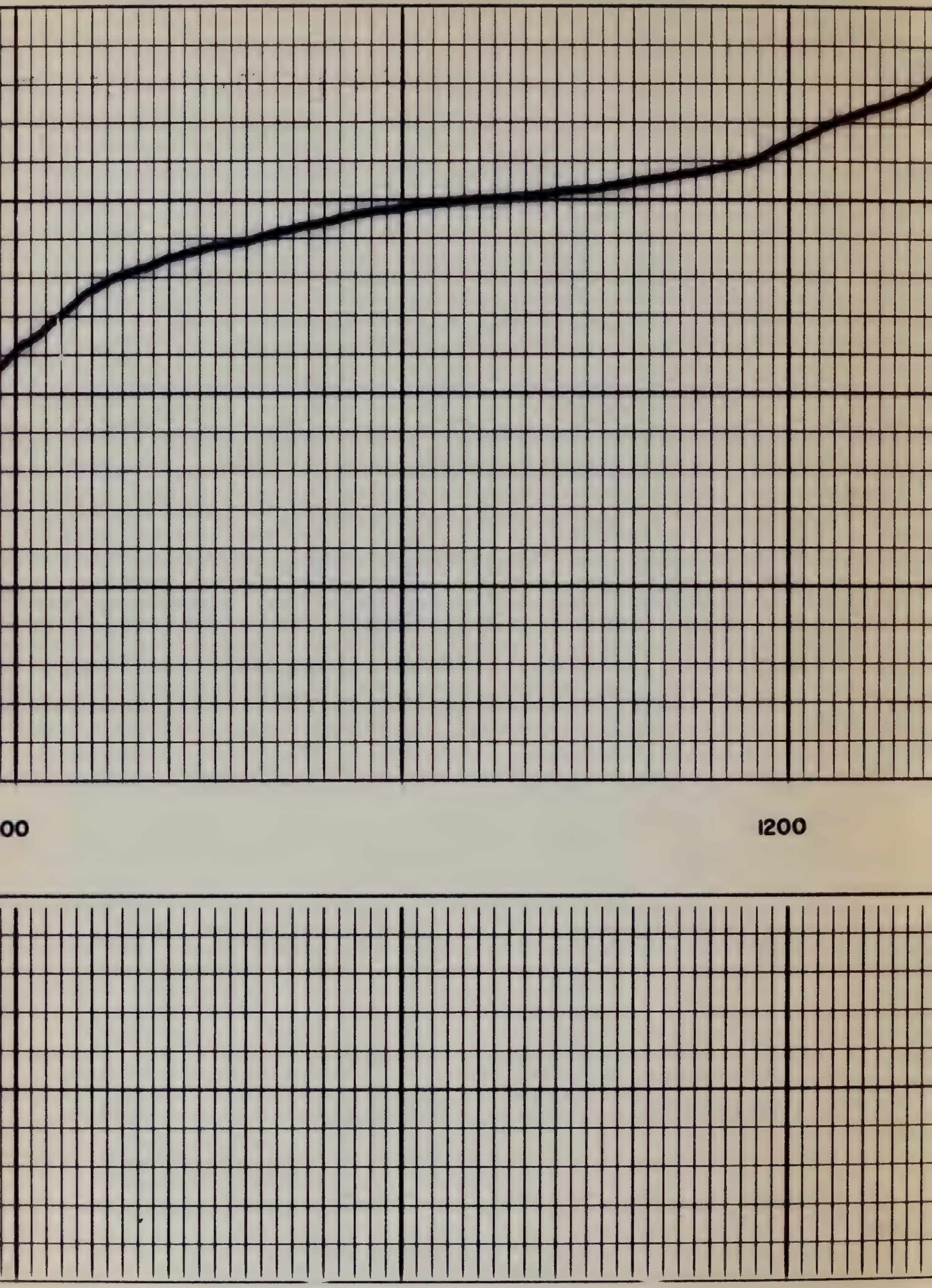

80
SCALE CHANGE
75
70
1300


1400
1500




80
90
75
SCALE CHANGE
85
70
80
1600


80
85
90
SCALE CHANGE
60
65
70
REPEAT SECTION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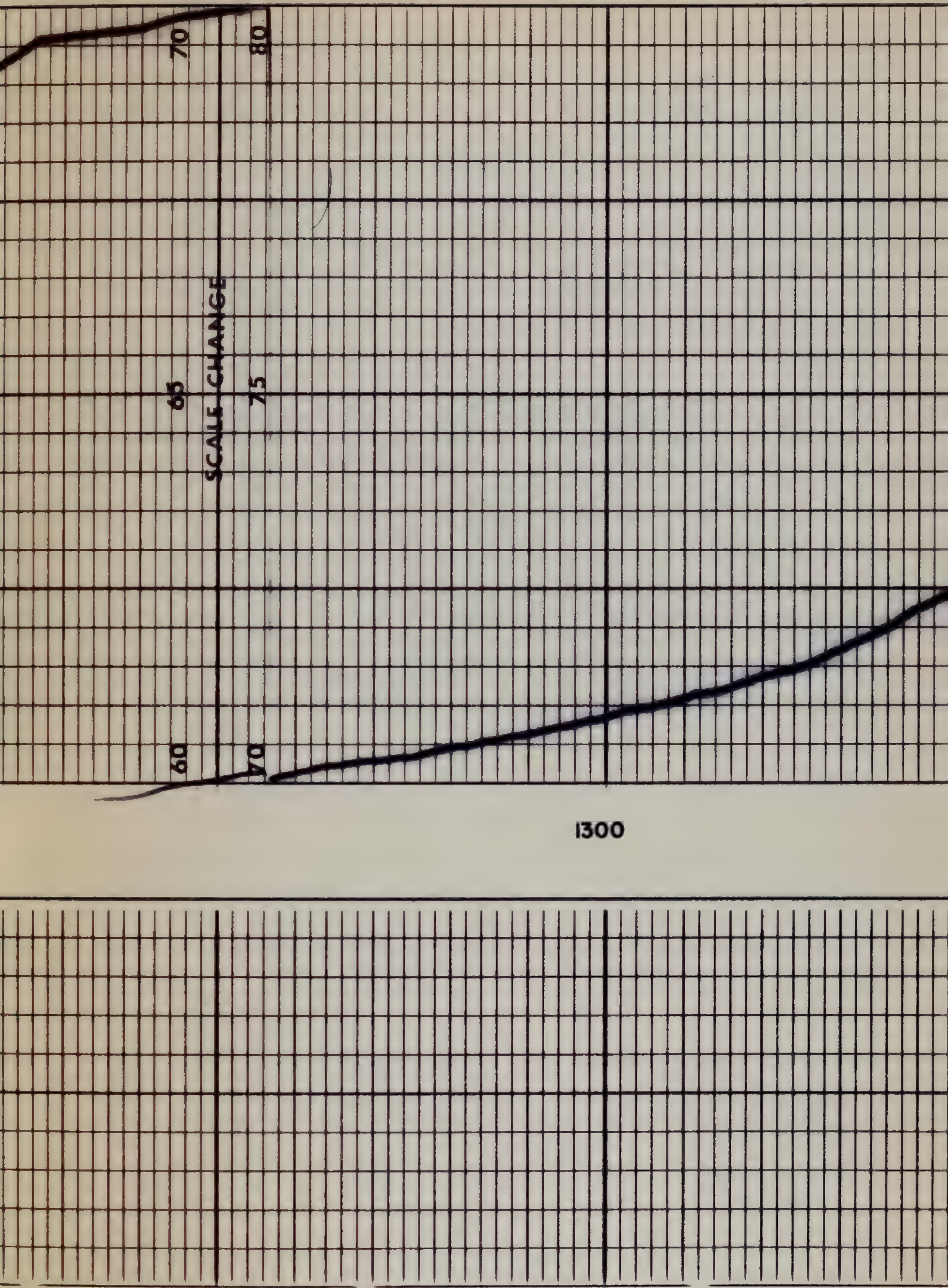
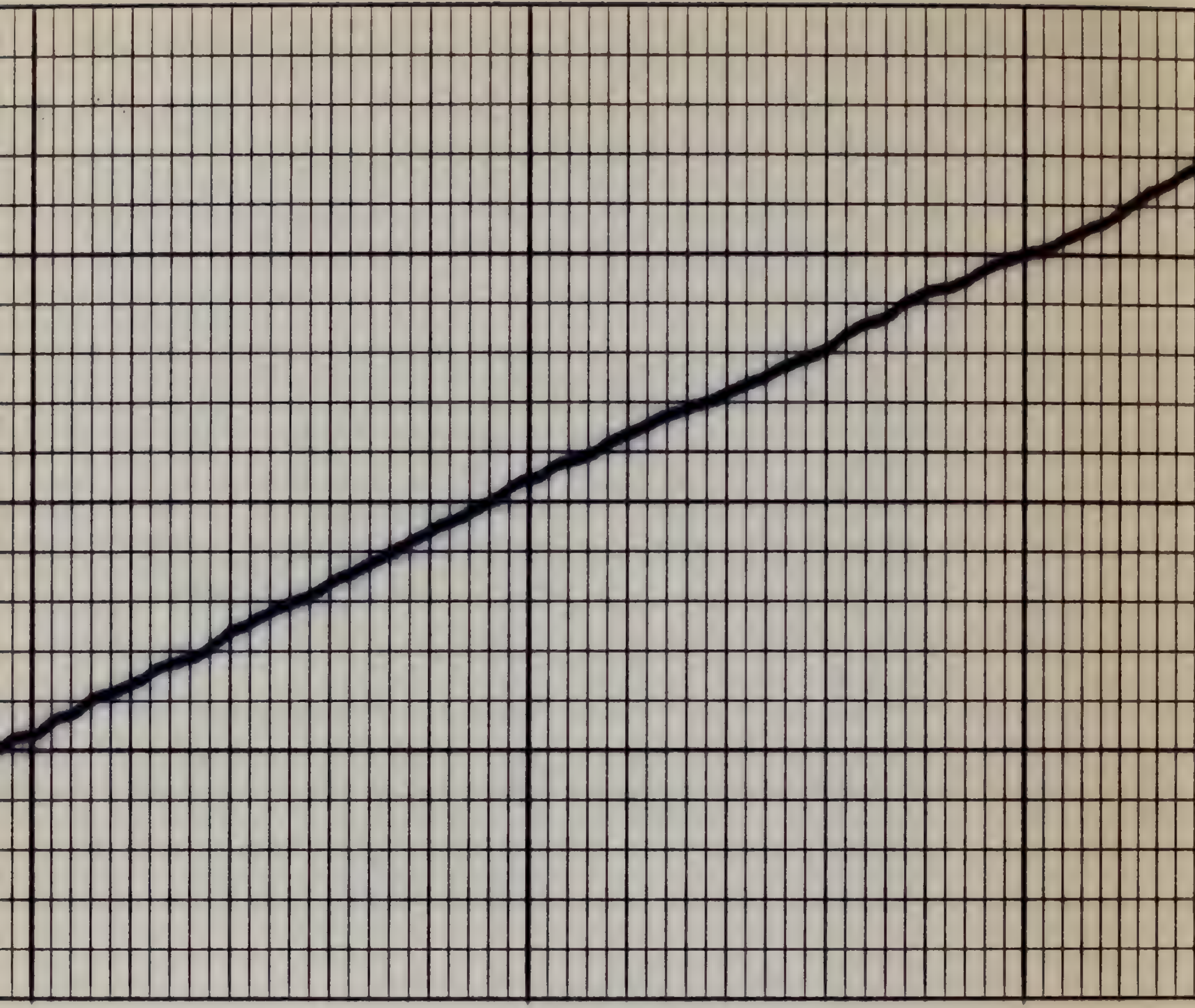

70
80
SCALE CHANGE
65
75
60
70
1300



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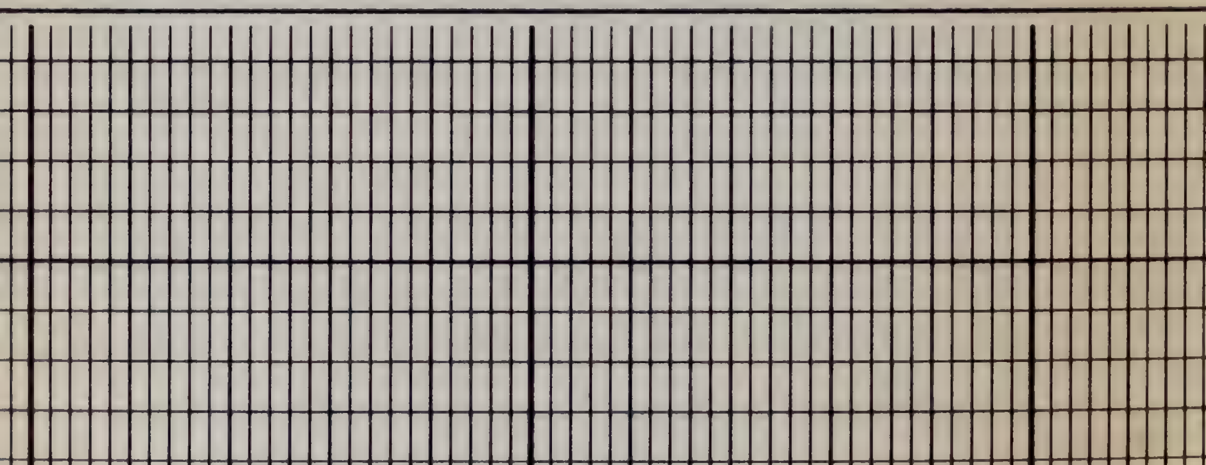
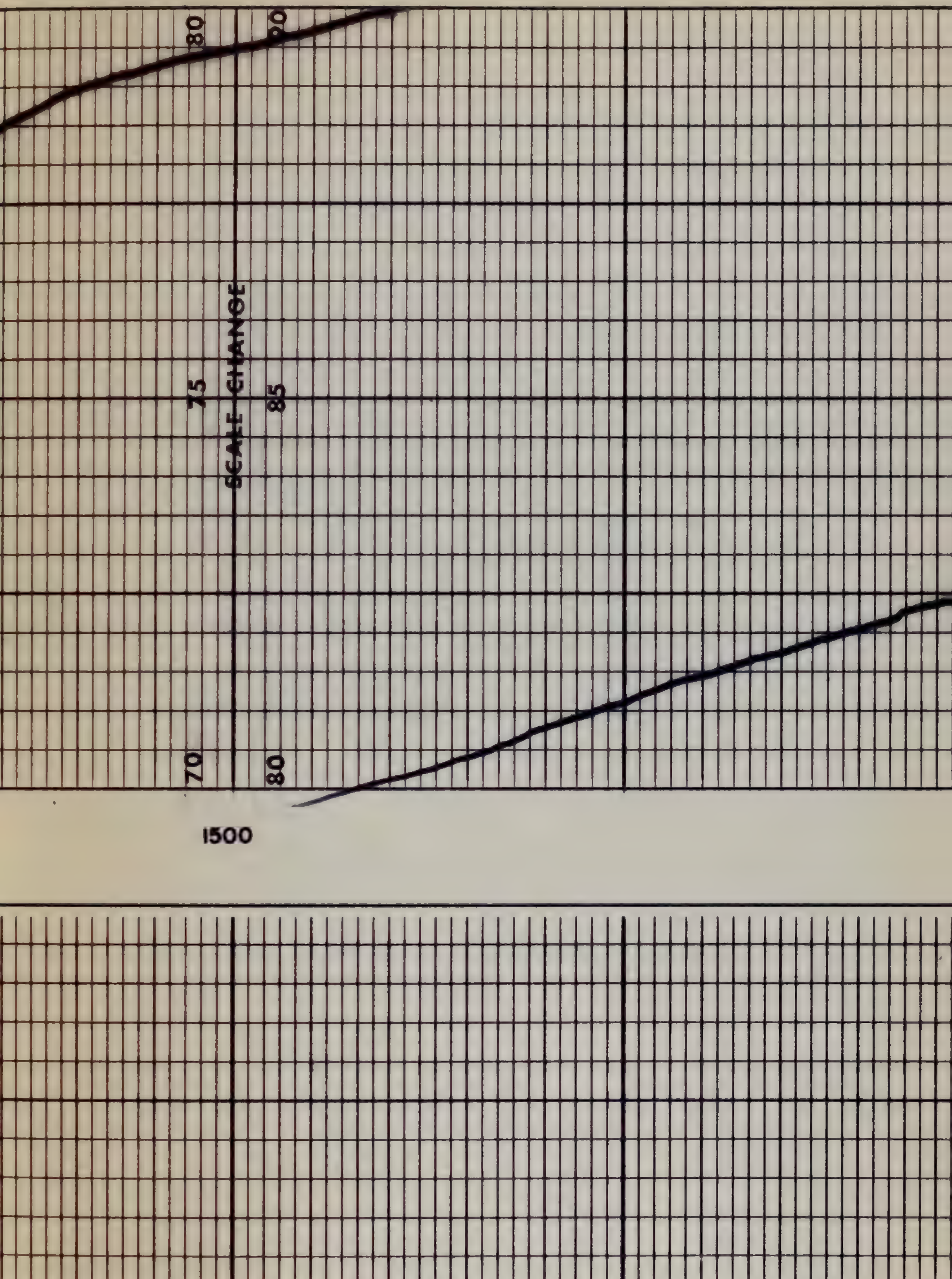
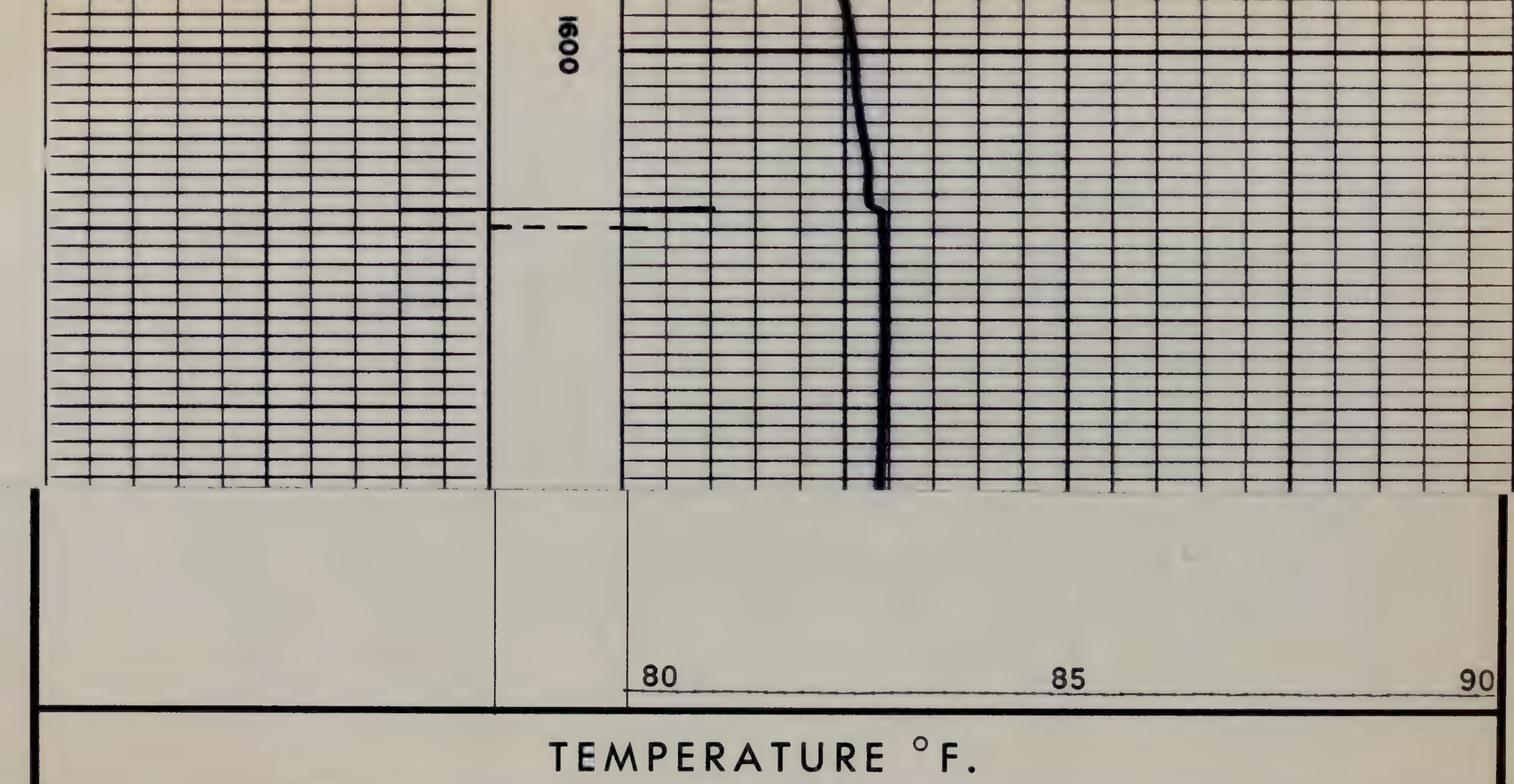



80
90
75
SCALE CHANGE
85
70
80
1500



COMPANY	ATLANTIC RICHFIELD COMPANY	SCHL. F. R.	1618
WELL	SORGUM GULCH AQUIFER NO. 1-A	SCHL. T. D.	1620
FIELD		DRLR. T. D.	1620
COUNTY	RIO BLANCO	STATE	COLORADO

Birdwell

3-Dimensional Velocity Log

FILING NO.

COMPANY ATLANTIC RICHFIELD COMPANY,
ET. AL.

WELL SORGHUM GULCH AQUIFER TEST #1-A

FIELD

COUNTY RIO BLANCO STATE COLORADO

LOCATION:

SEC. 7 TWP. 3S RGE. 96W

OTHER SERVICES:
CAL FDL ES
TL GR/ENP

ELEVATIONS
KB.
DF.
GL. 6909'

PERMANENT DATUM GROUND LEVEL ELEV. 6909'
LOG MEASURED FROM GL
DRILLING MEASURED FROM GL

DATE	2 JULY 74	2 JULY 74	
RUN NO.	2	2	
TYPE LOG—BOND OR VEL.	V3D	V3D	
DEPTH — DRILLER	1621	1621	
DEPTH — LOGGER	1620	1620	
BOTTOM LOGGED INTERVAL	1610	1610	
TOP LOGGED INTERVAL	400	400	
TYPE FLUID IN HOLE	WATER	WATER	
SALINITY PPM CL.			
DENSITY LB./GAL.			
LEVEL	412	412	
MAX. REC. TEMP. — DEG. F.	78°	78°	
OPR. RIG TIME	1 HR.	1 HR.	
RECORDED BY	WILSON	WILSON	
WITNESSED BY	TAIT	TAIT	
LOCATION	LAS VEGAS	LAS VEGAS	

RUN NO.	BORE HOLE RECORD			CASING RECORD			
	BIT	FROM	TO	SIZE	WGT.	FROM	TO
1				7"		0	62'
	6-1/4"	62'	1621'				

SSC-636-1-A

EQUIPMENT DATA

SURFACE

RUN NO.	1	2
CAMERA MODEL NO.	LLAD	LLAD
SWEEP DELAY — μSEC.	0	100
TOTAL SWEEP TIME — μSEC.	2000	2000
LOGGING SPEED FT./MIN.		
DEPTH SCALE FT./MARK		
TIMING LINES	100	100

SUB-SURFACE

RUN NO.	1	2
TX TRANSDUCER SIZE	3-5/8"	3-5/8"
ISOLATOR LENGTH	27-3/4"	57"
CENTER TO CENTER	37-3/4"	67"
BUMPER O.D.		
BOREHOLE GAIN — /DB	3RD	4TH

GENERAL

HOIST TRUCK NO.	2694	2694
INST. TRUCK NO.	2694	2694
STATION	LAS VEGAS	LAS VEGAS

WELL DATA

TYPE WELL	
COMPLETION DATE	
WELL DRILLED WITH	ROTARY ☒ CABLE T. ☐

CEMENTING DATA

DATE, PRIMARY		
TYPE CEMENT		
AMOUNT		
ADDITIVES BY %		
DATE, SQUEEZE		
TYPE CEMENT		
AMOUNT		
ADDITIVES BY %		

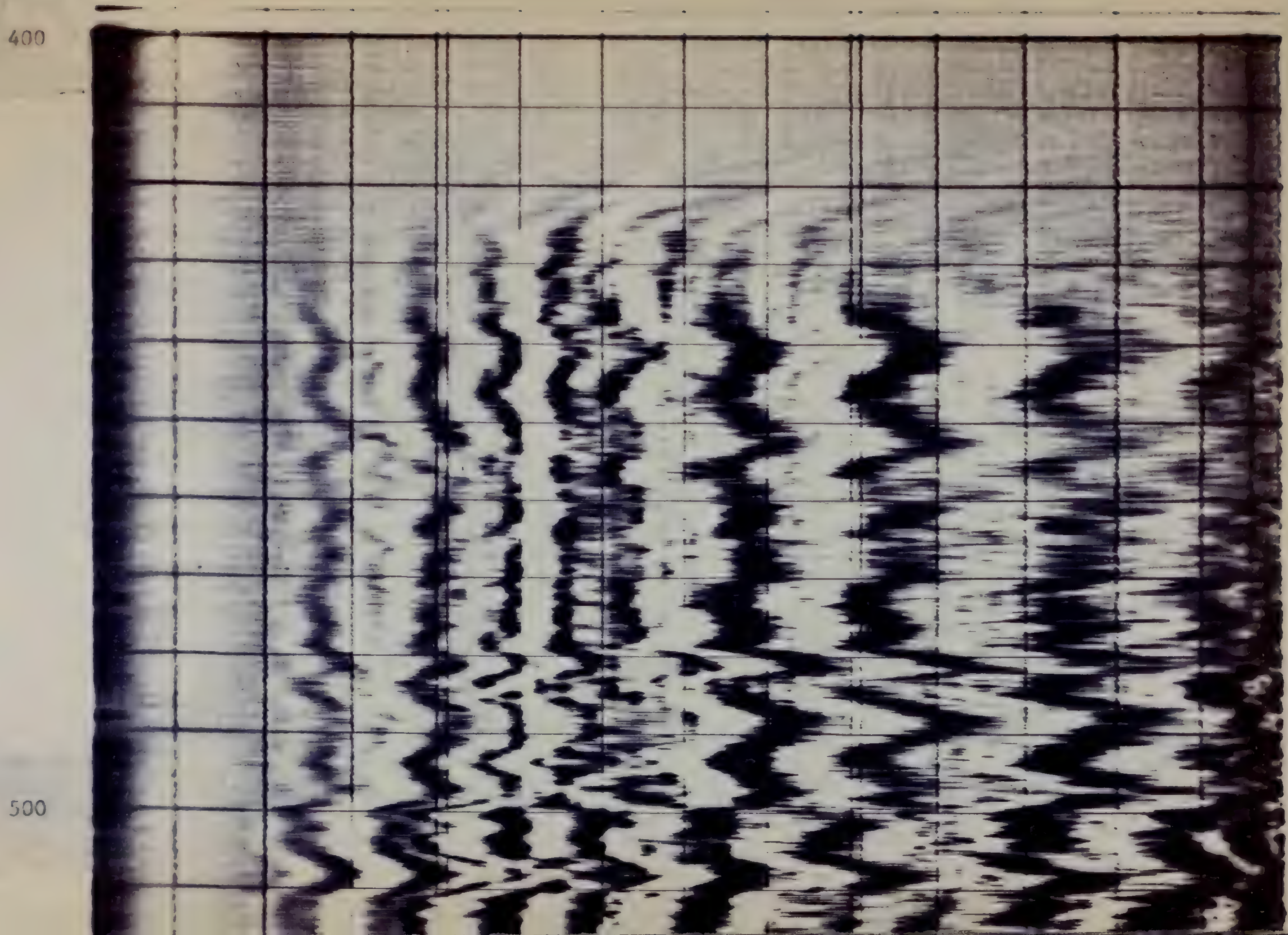
REMARKS

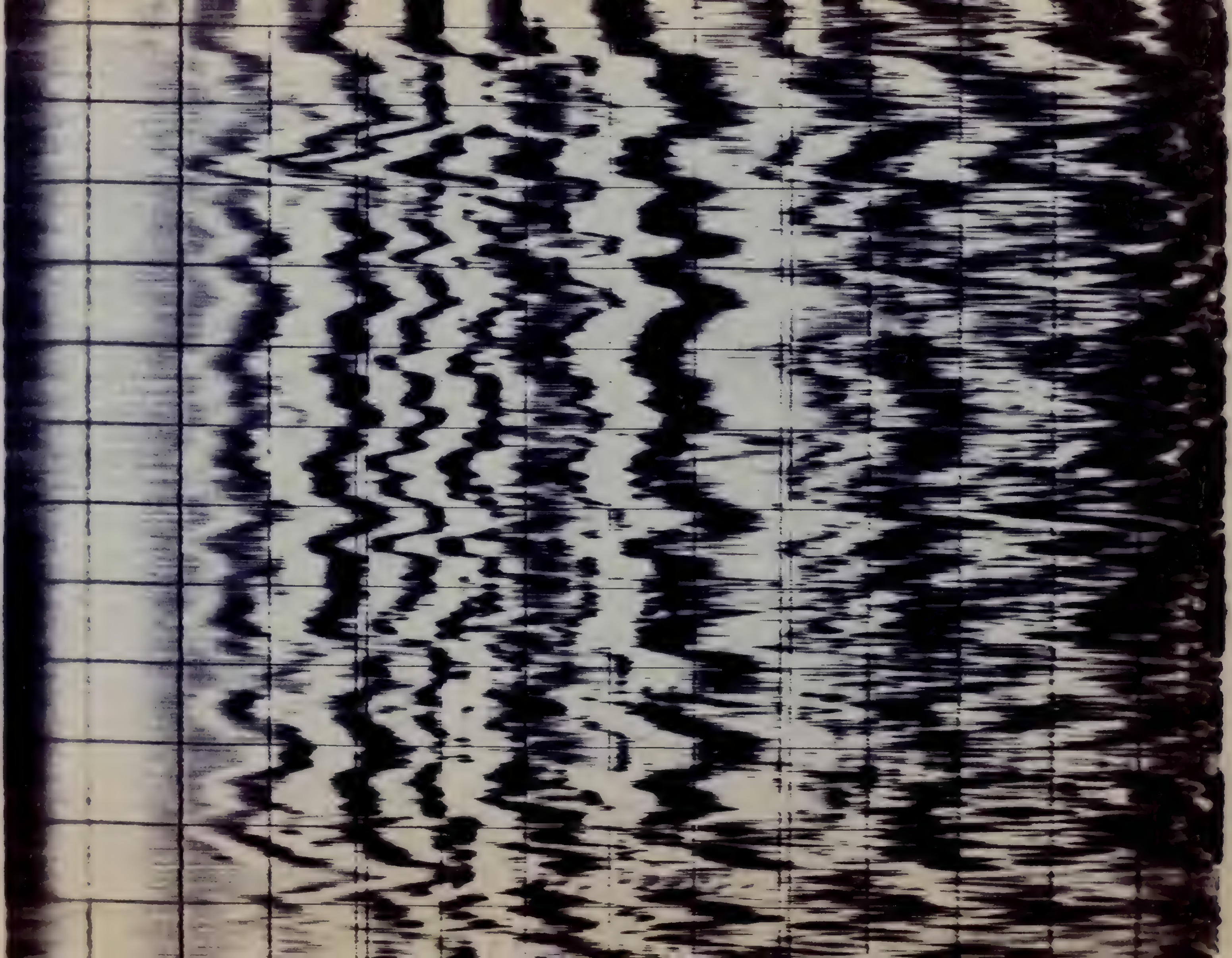
←——— MICROSECONDS INCREASING ———→

DEPTH

RUN # 1 3' SPACING

500 1000


400
500



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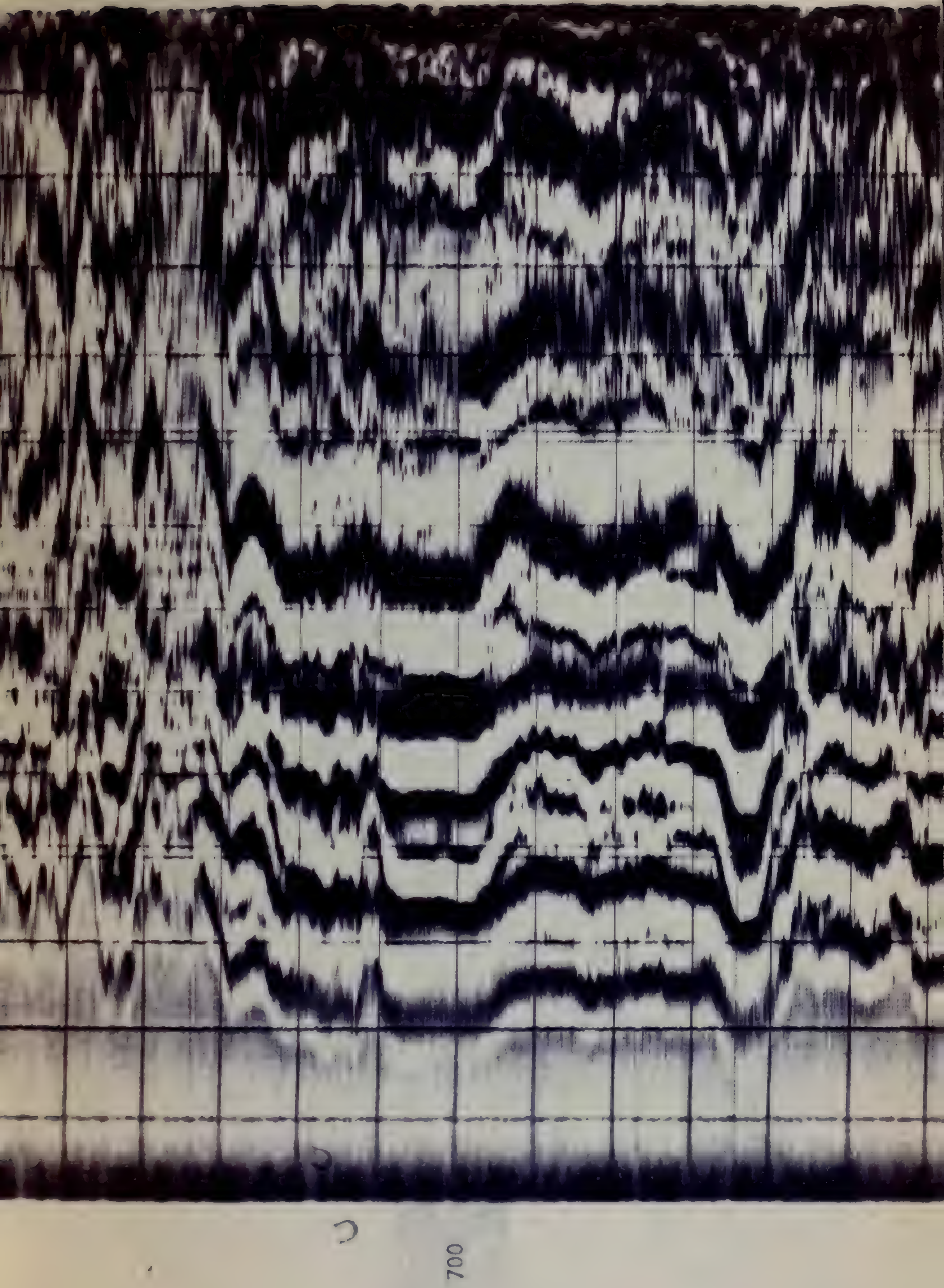
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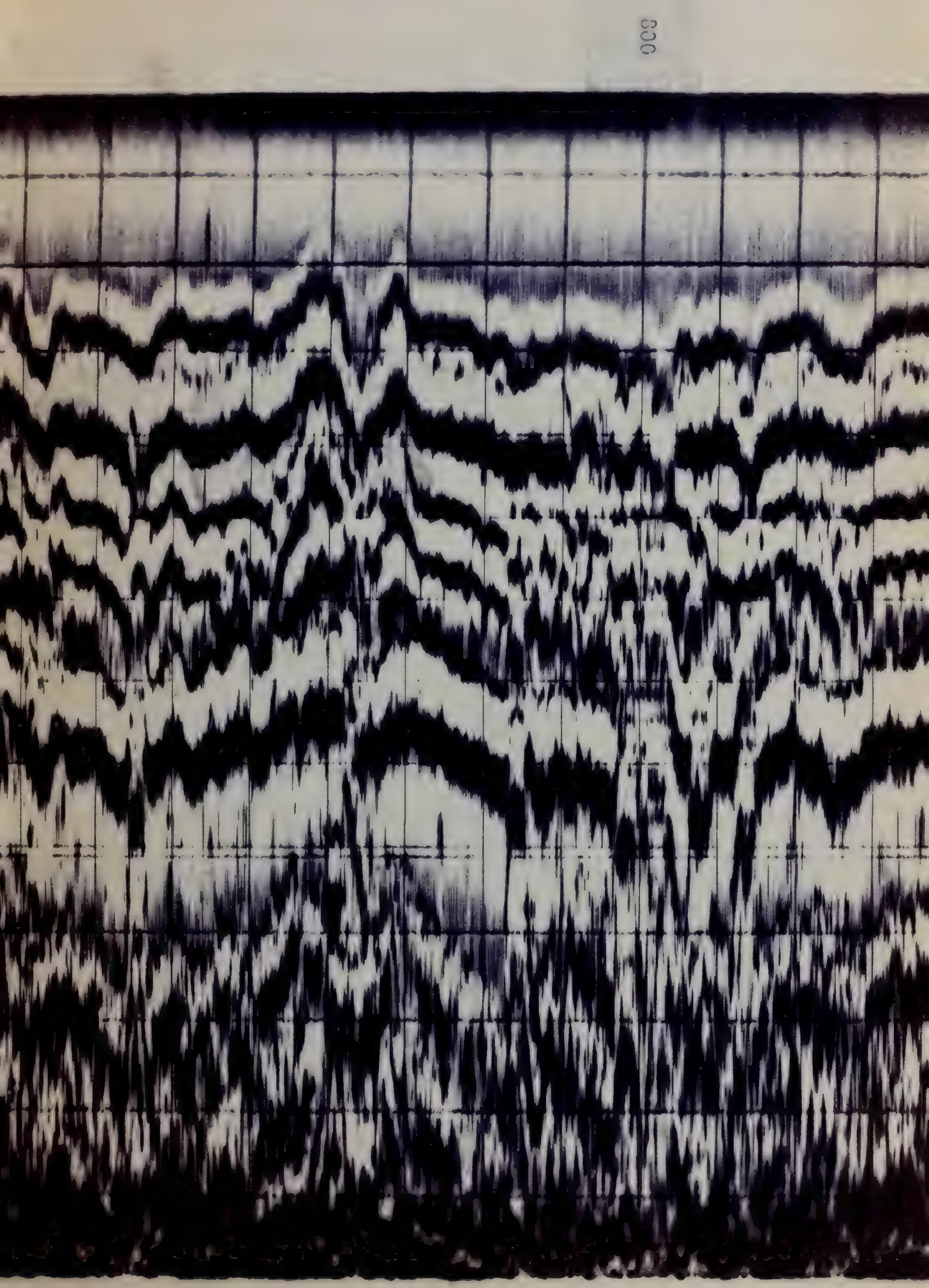
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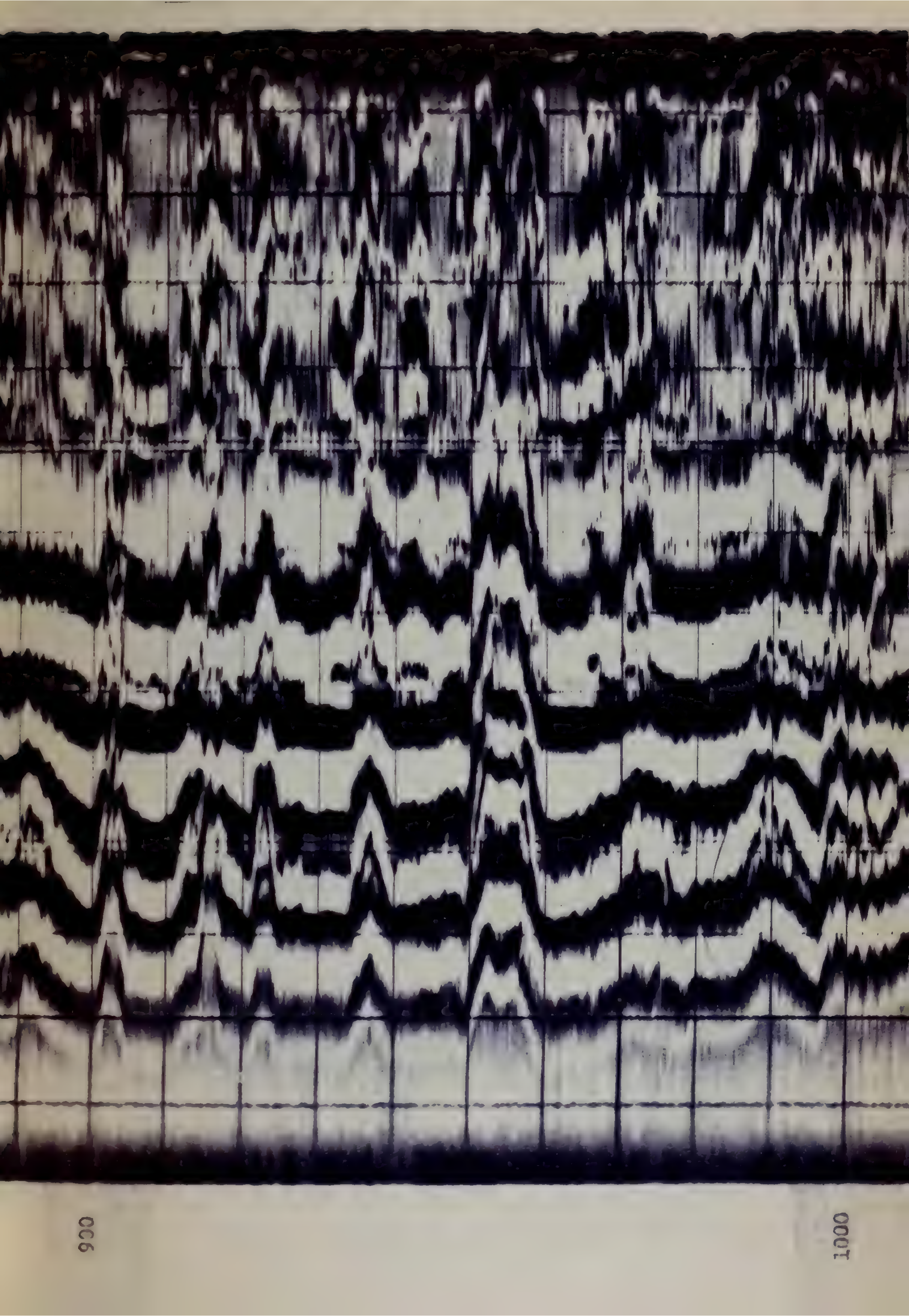
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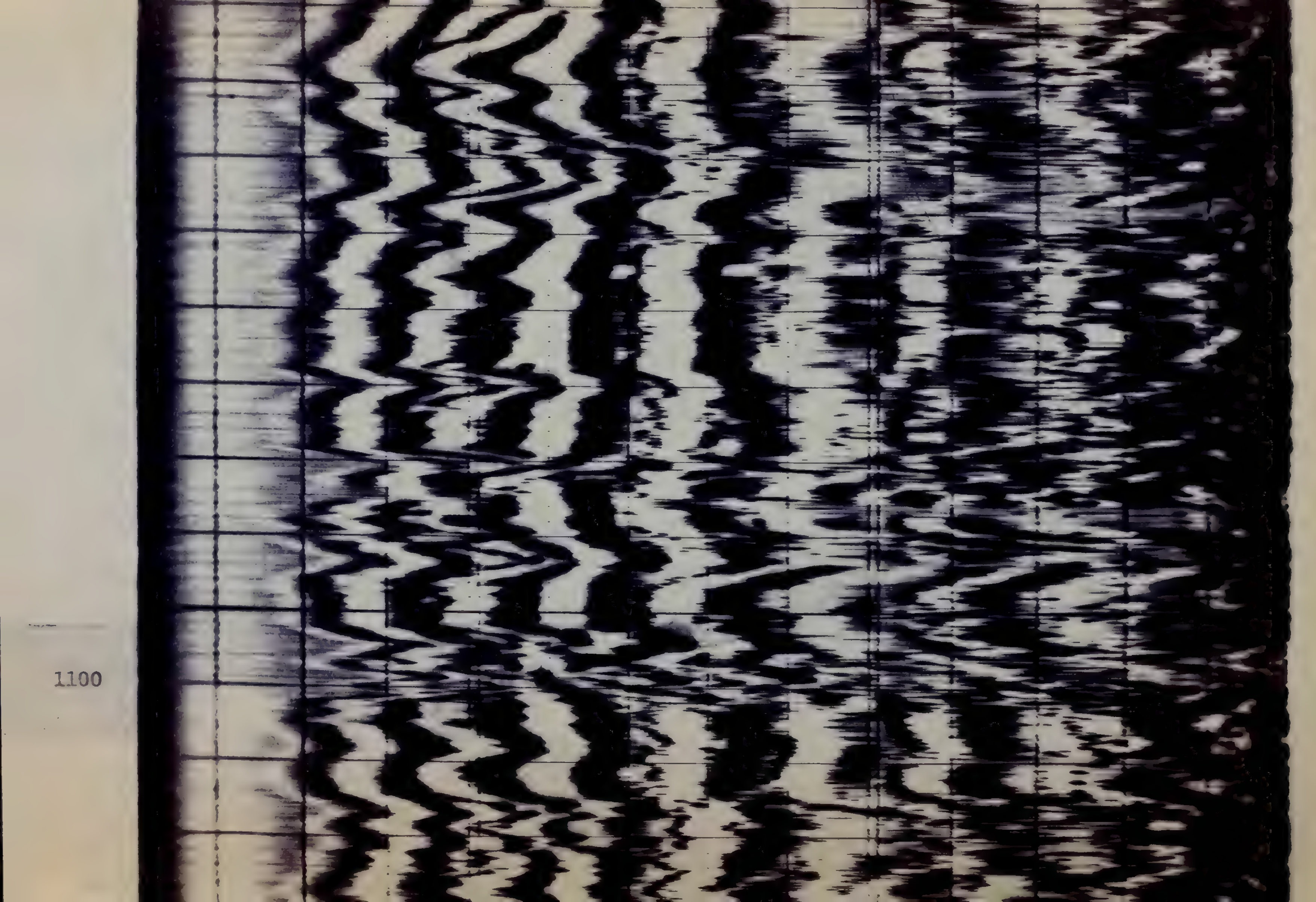
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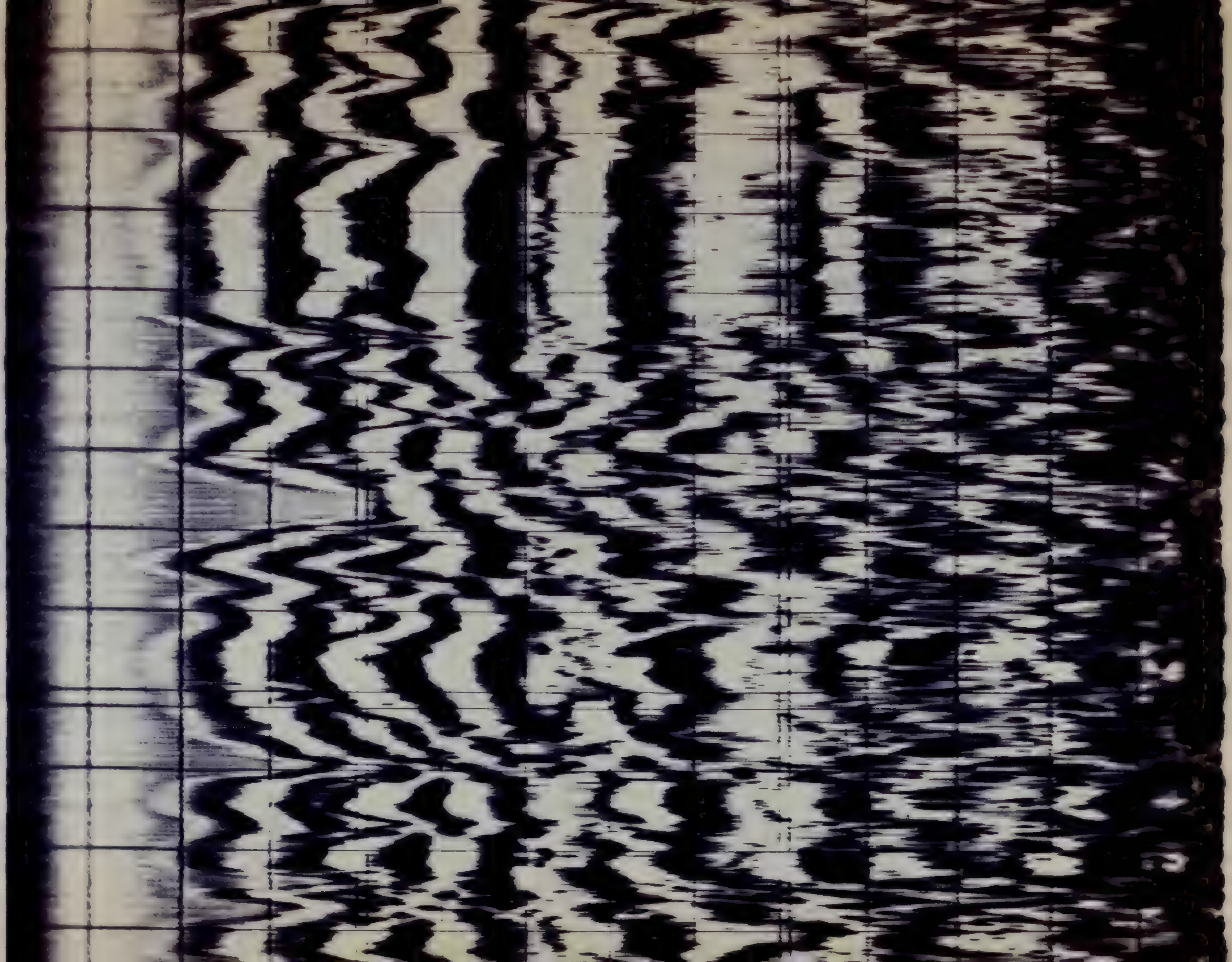
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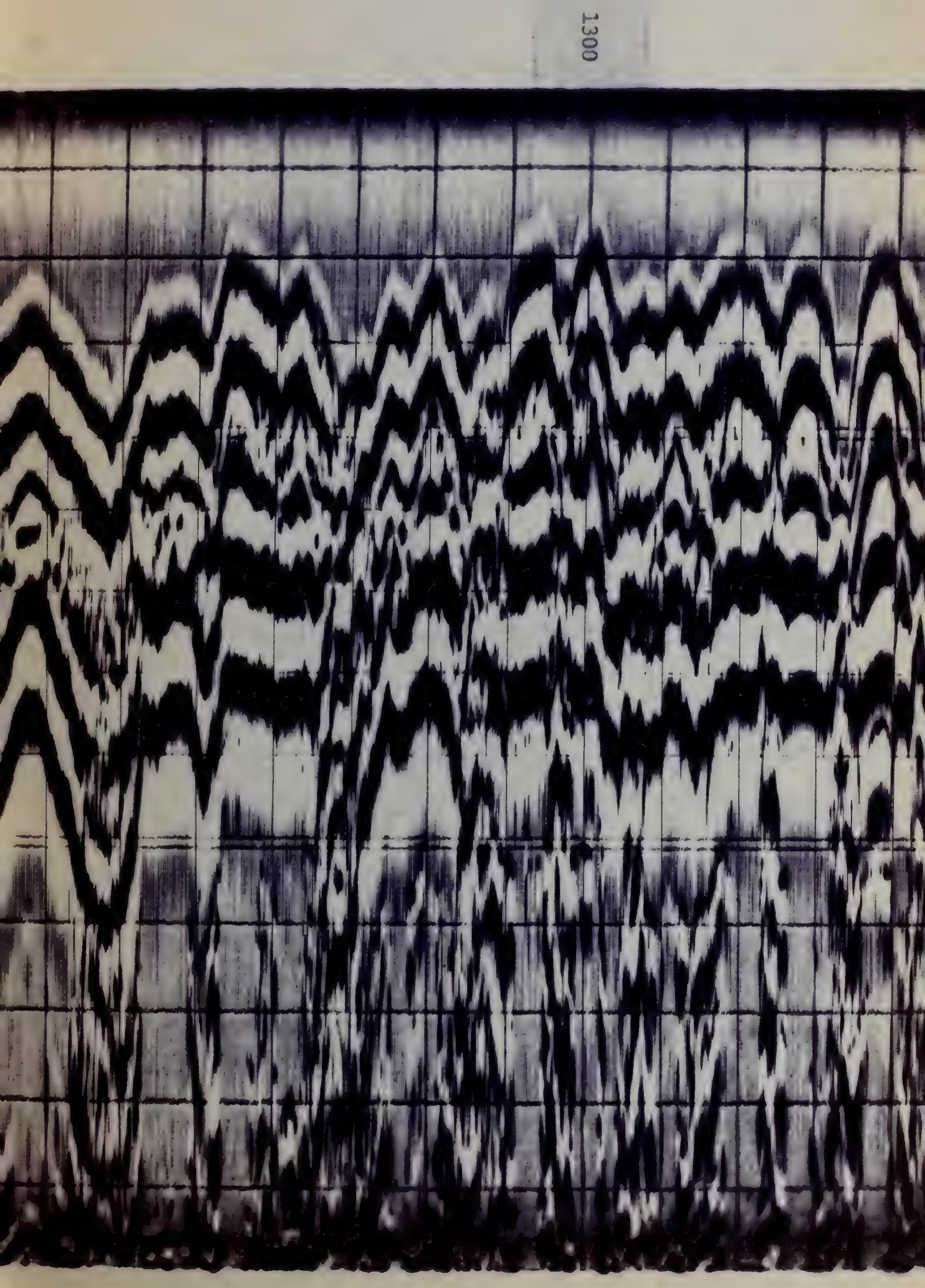
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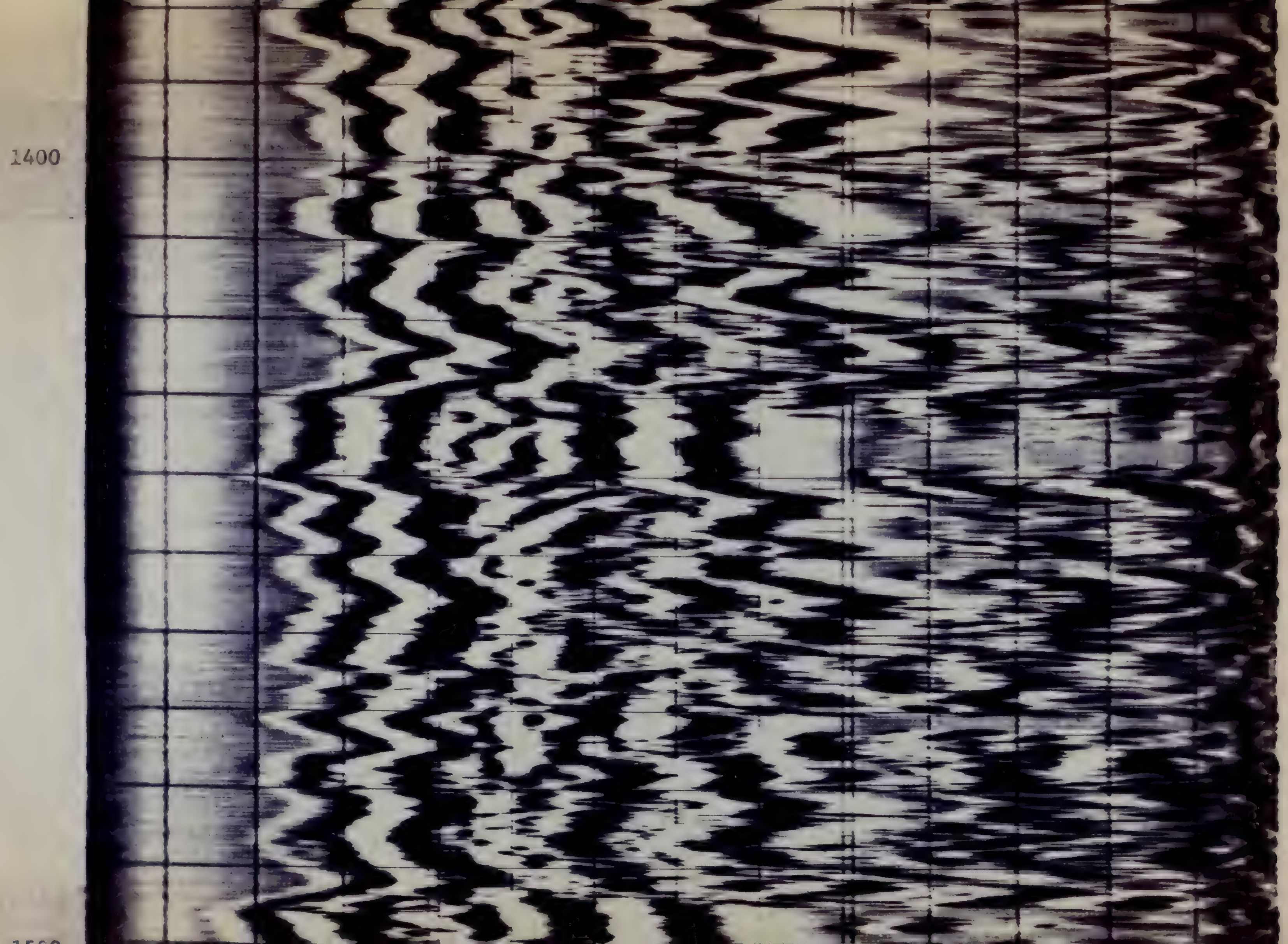
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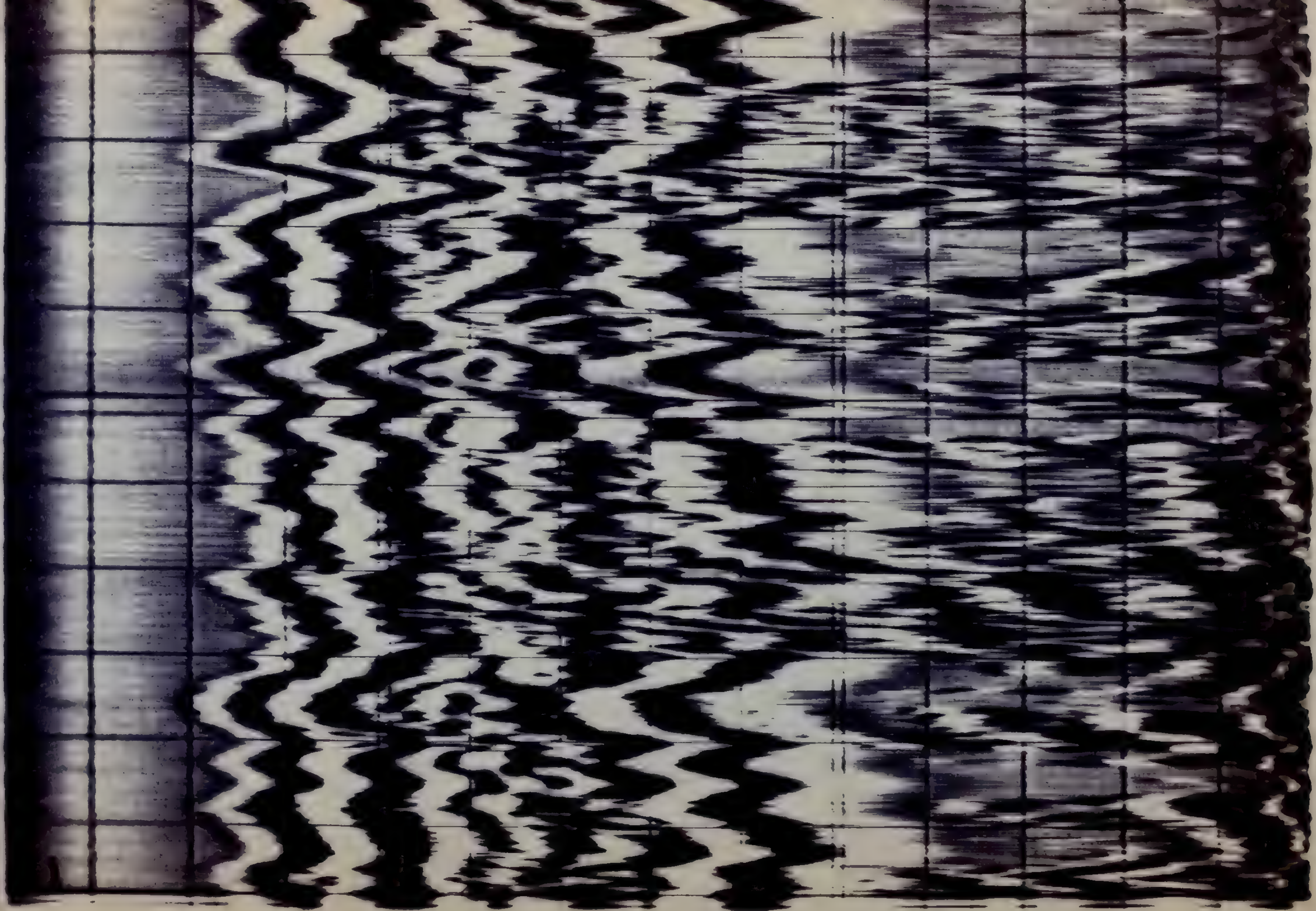
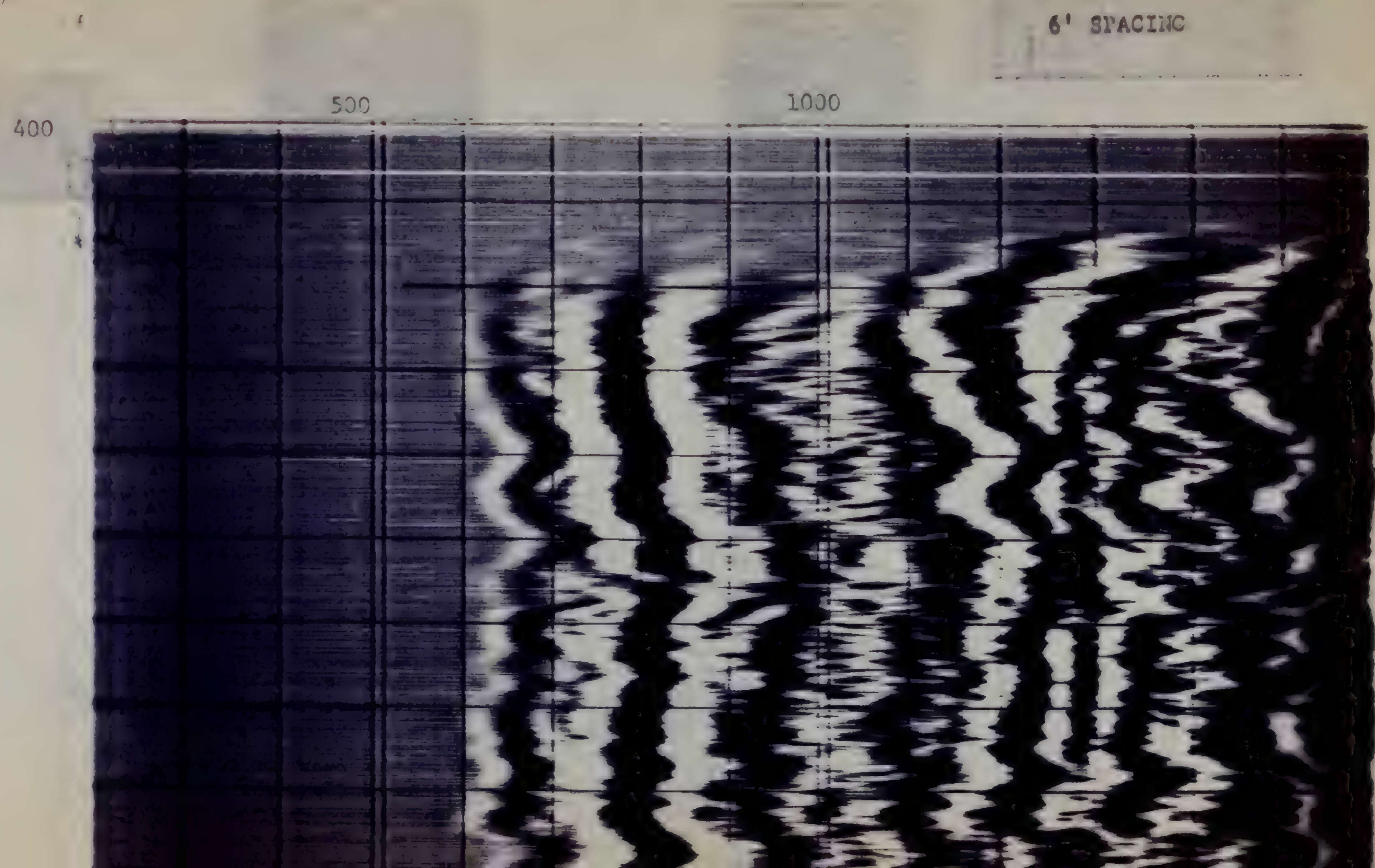
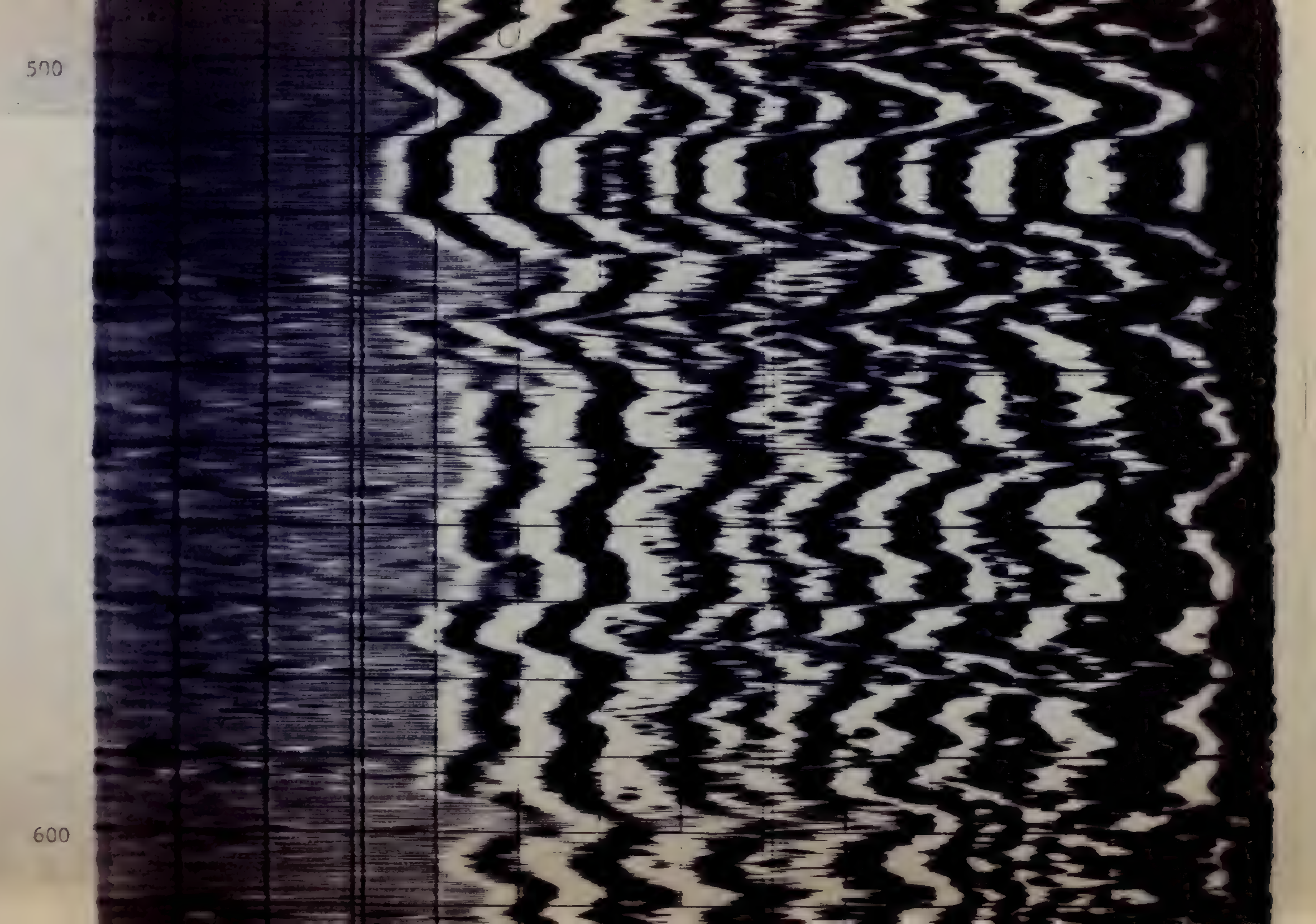


1600
T.D.
1020'


6' SPACING
400
500
1000


500
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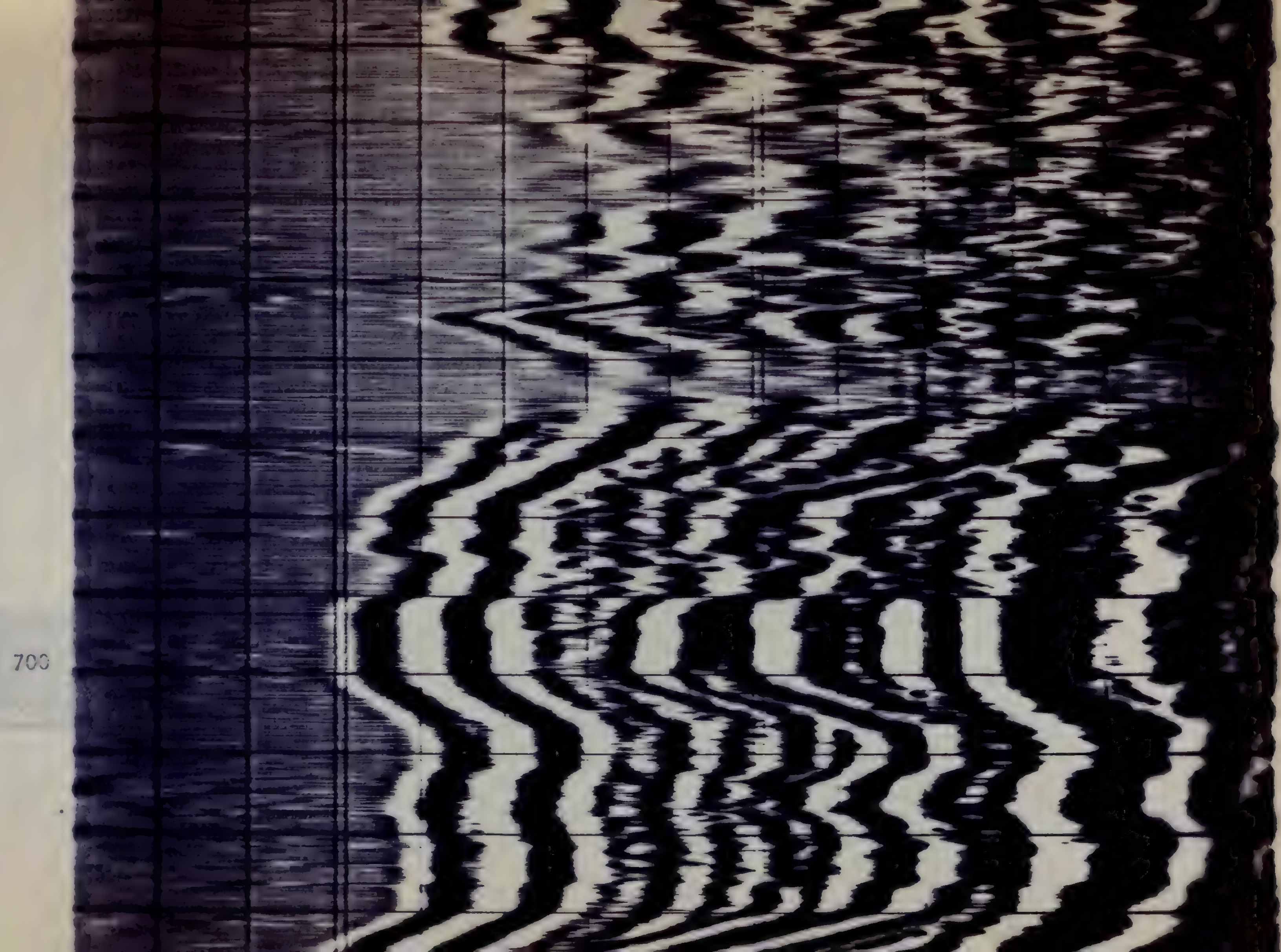
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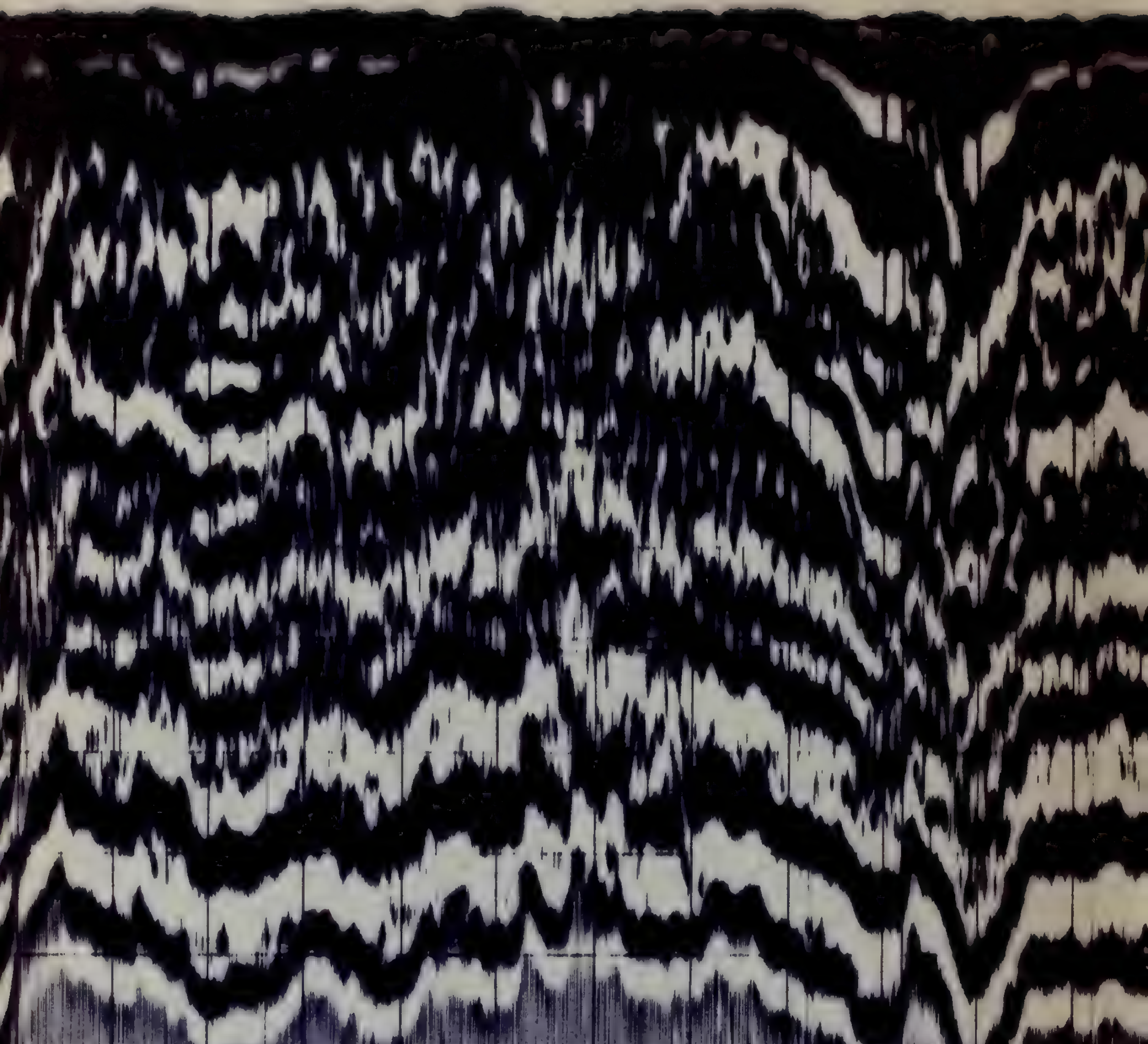
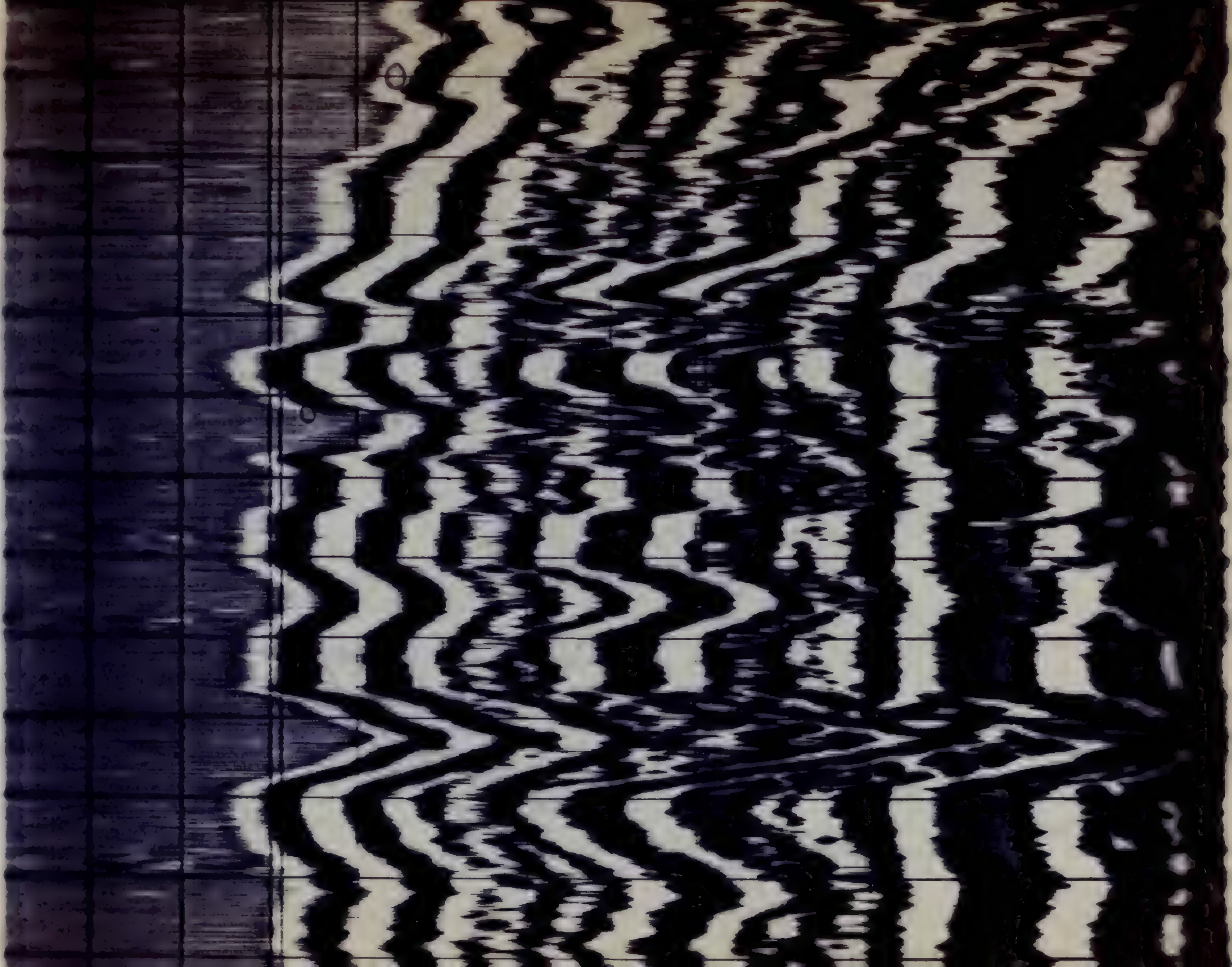
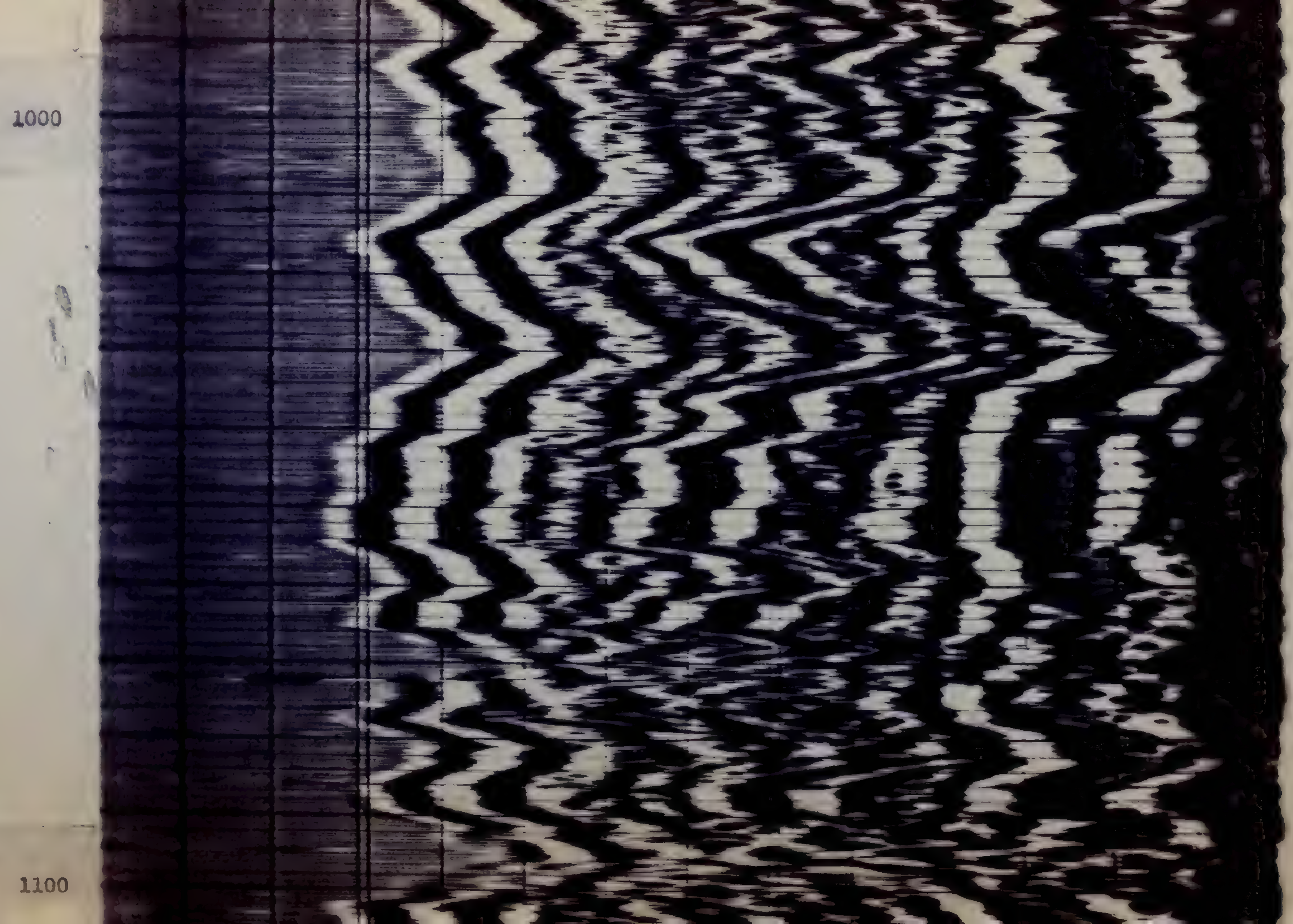
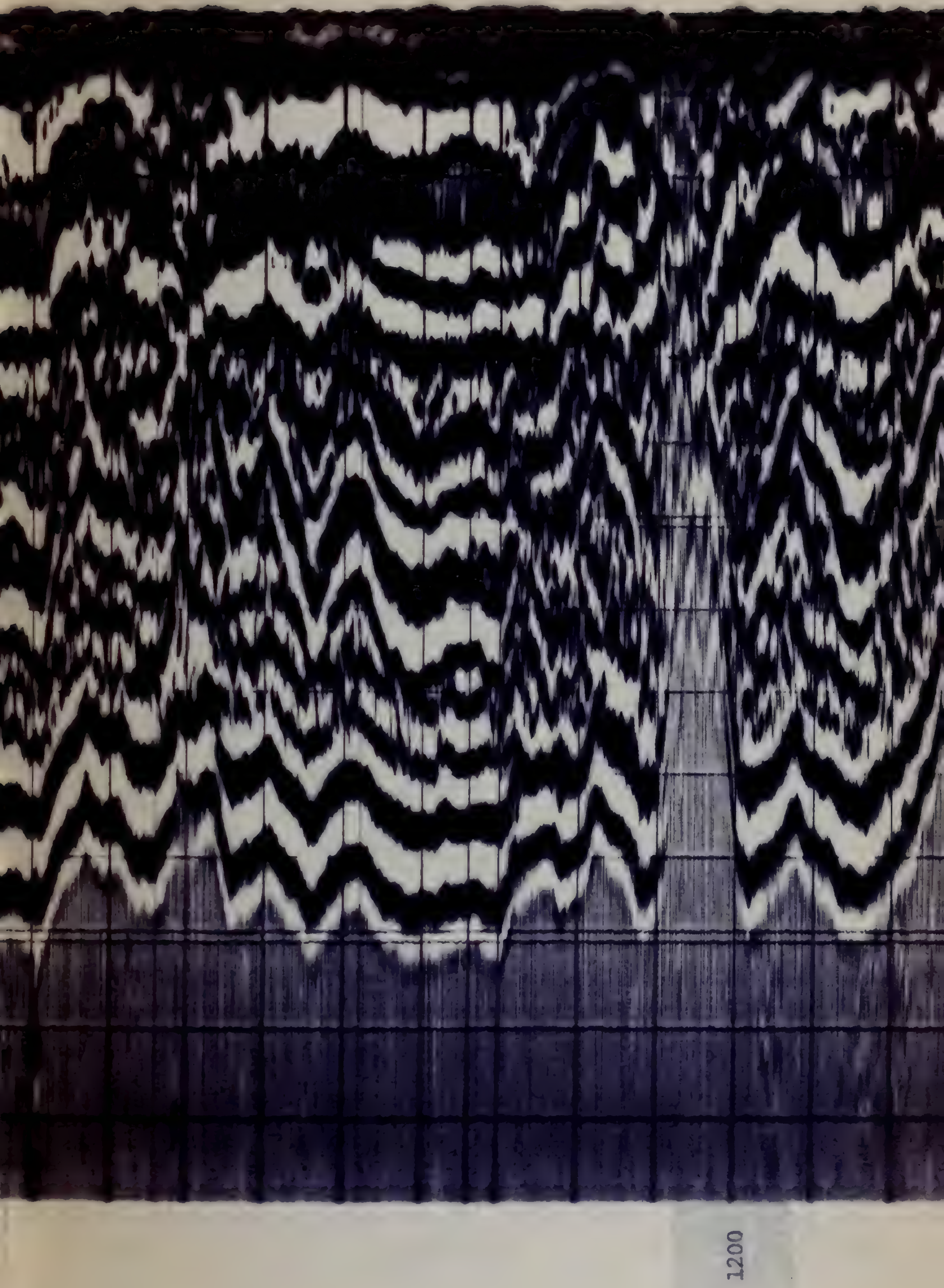

800

900




1000
1100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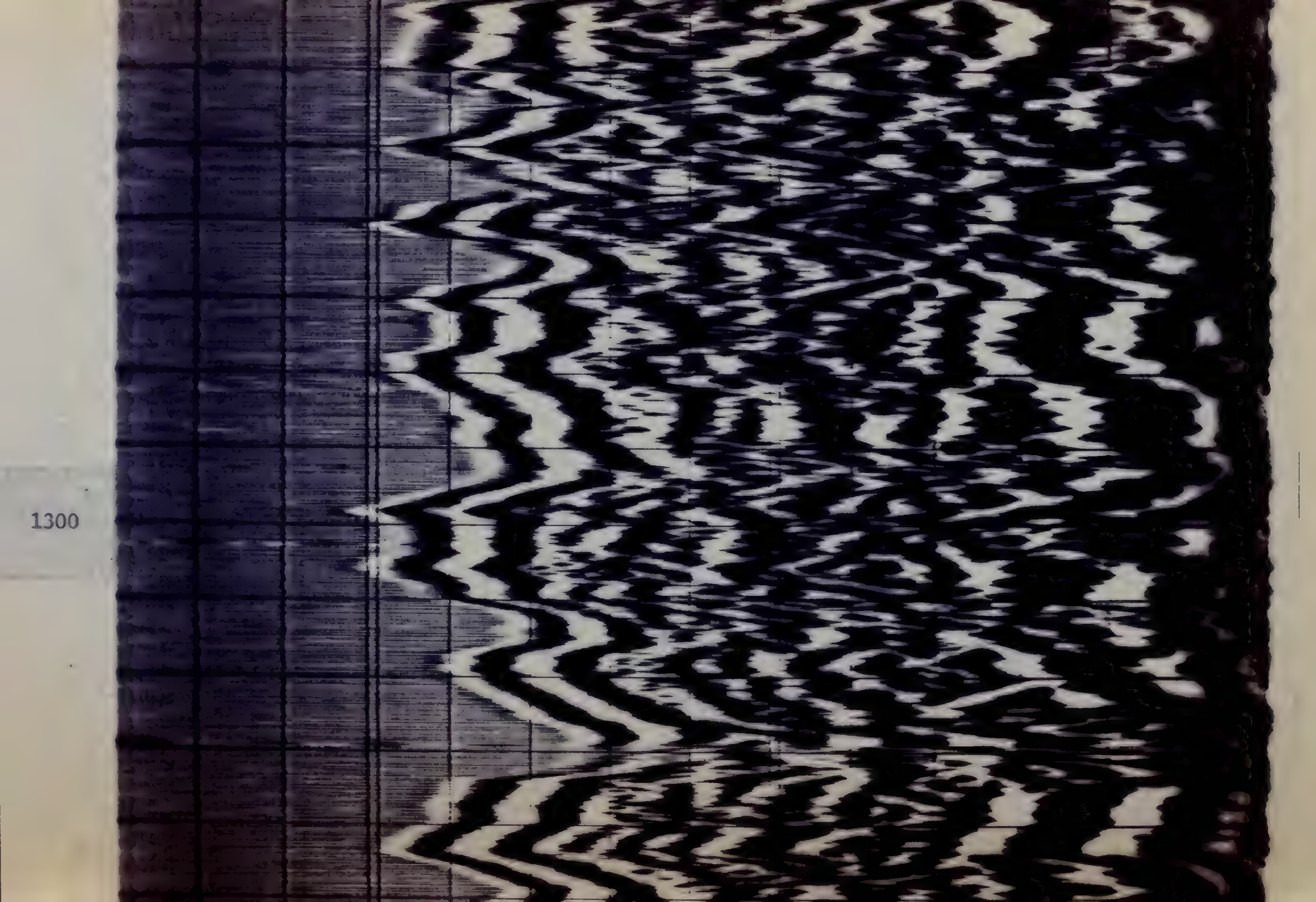
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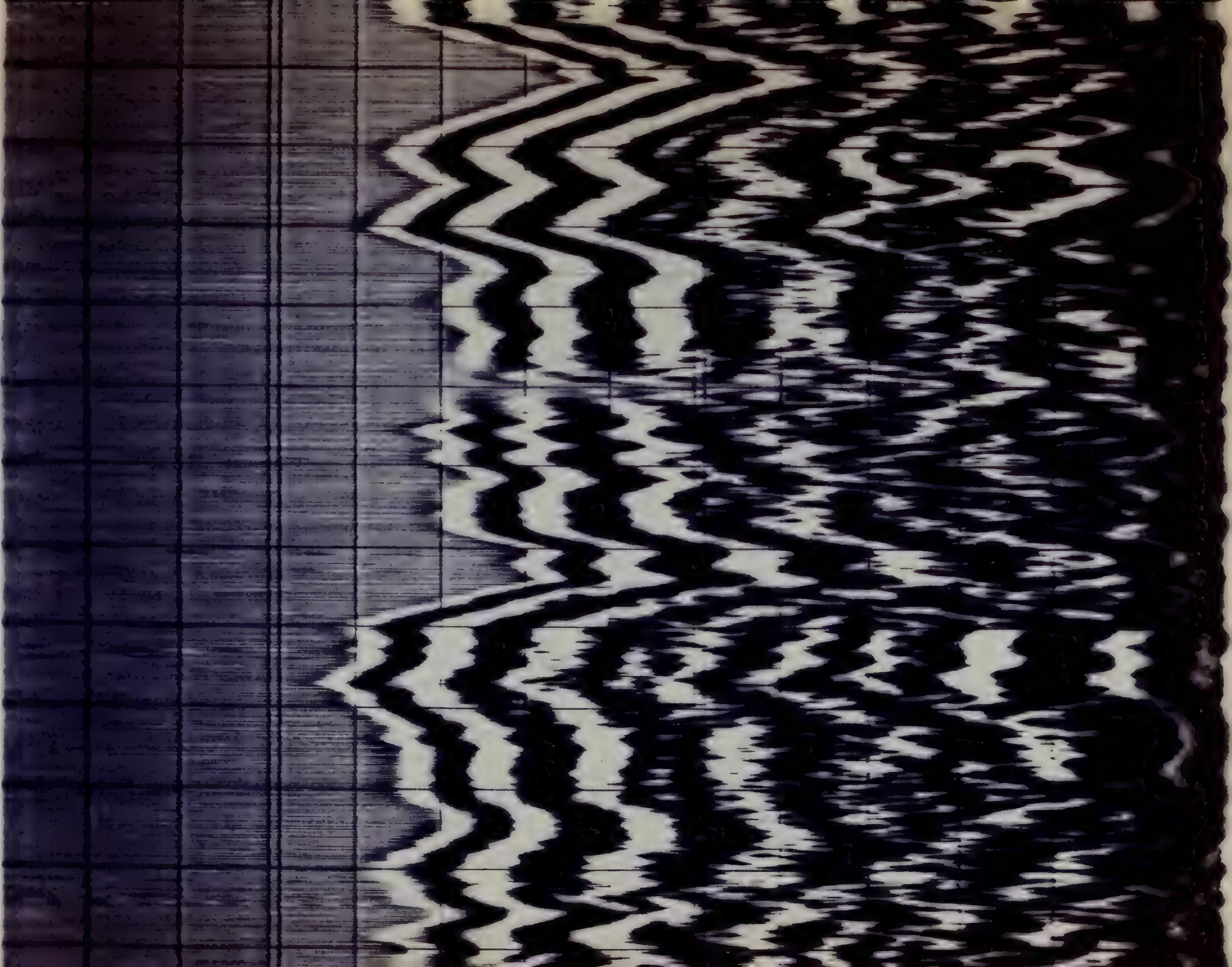
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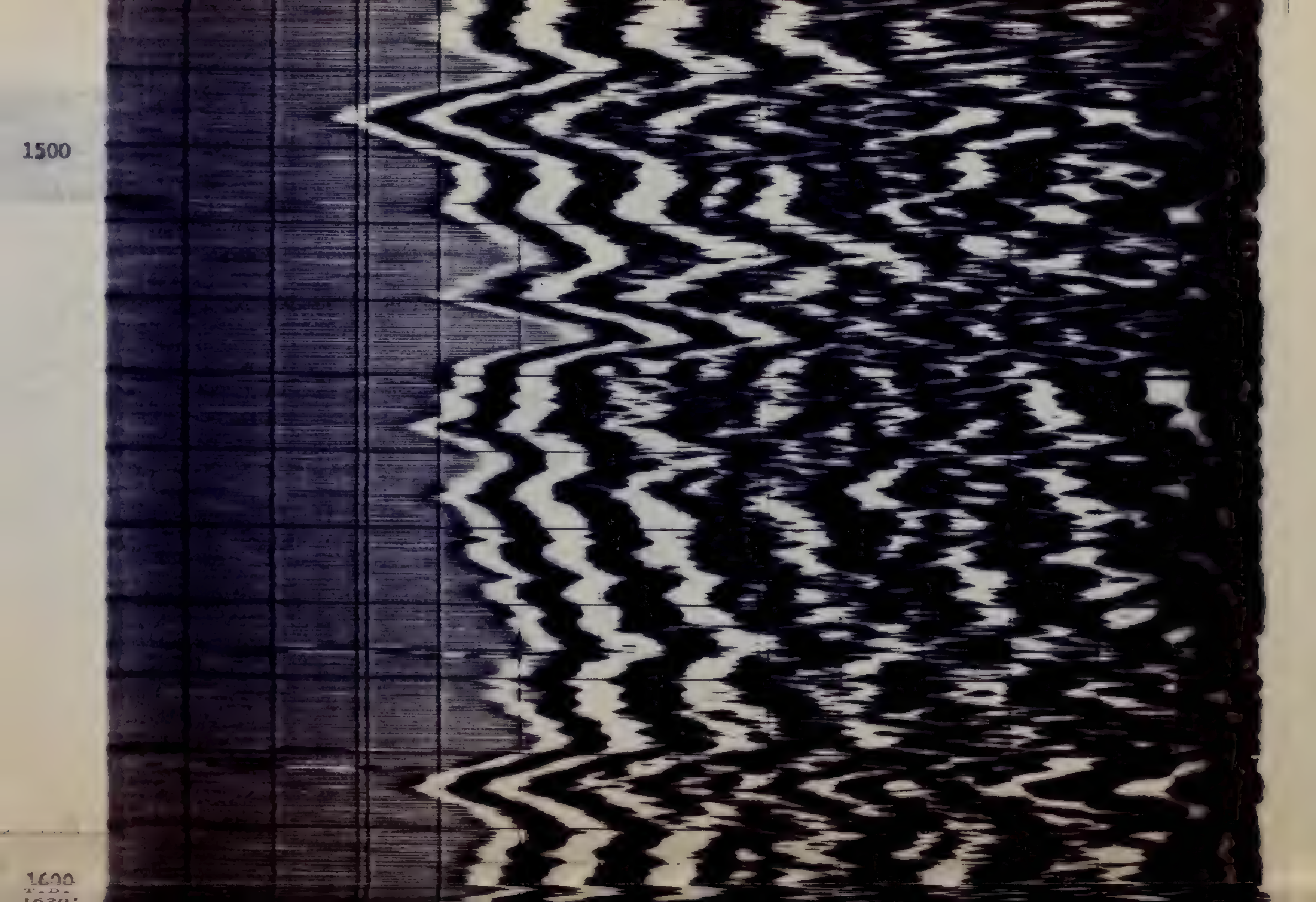

1500
1600
T.D.
1630'

T.D.
1620'

SSC
Birdwell
DIVISION

Birdwell

Electric Log

COMPANY ATLANTIC RICHFIELD COMPANY,
ET. AL.

WELL SORGHUM GULCH AQUIFER TEST #1-A

FIELD

COUNTY RIO BLANCO **STATE** COLORADO

LOCATION:

SEC. 7 TWP. 3S RGE. 96[illegible]

OTHER SERVICES:

CAL V3D FDL
GR/ENP TL

PERMANENT DATUM GROUND LEVEL ELEV. 6909'
LOG MEASURED FROM GL , FT. ABOVE PERM. DATUM
DRILLING MEASURED FROM GL

ELEV. K.B.
D.F.
G.L. 6909'

DATE	2 JULY 74			
RUN NO.	1			
DEPTH—DRILLER	1621			
DEPTH—LOGGER	1620			
BTM. LOG INTER.	1618			
TOP LOG INTER.	430			
CASING—DRILLER	7" @ 62'	@	@	@
CASING—LOGGER	62			
BIT SIZE	6-1/4"			
TYPE FLUID IN HOLE	WATER			
DENS. | VISC.				
pH | FLUID LOSS	ml	ml	ml	ml
SOURCE OF SAMPLE	PIT			
Rm @ MEAS. TEMP.	9 @ 74 °F	@ °F	@ °F	@ °F
Rmf @ MEAS. TEMP.	@ °F	@ °F	@ °F	@ °F
Rmc @ MEAS. TEMP.	@ °F	@ °F	@ °F	@ °F
SOURCE Rmf | Rmc				
Rm @ B.H.T.	@ 78 °F	@ °F	@ °F	@ °F
TIME SINCE CIRC.	11 HRS.			
MAX. REC. TEMP.	78 °F	°F	°F	°F
EQUIP. | LOCATION	2694 LAS VEGAS			
RECORDED BY	WILSON			
WITNESSED BY	TAIT			

THIS HEADING AND LOG CONFORM TO API RP-31 ®

SSC-605. C

REMARKS NA-NOT AVAILABLE

CHANGES IN MUD TYPE OR ADDITIONAL SAMPLES

DATE	SAMPLE NO.				
DEPTH—DRILLER					
TYPE FLUID IN HOLE					
DENS.	VISC.				
pH	FLUID LOSS		ml		ml
SOURCE OF SAMPLE					
R_m @ MEAS.TEMP.		@	°F	@	°F
R_{mf} @ MEAS.TEMP.		@	°F	@	°F
R_{mc} @ MEAS.TEMP.		@	°F	@	°F
SOURCE R_{mf}	R_{mc}				
R_m @ B.H.T.		@	°F	@	°F
R_{mf} @ B.H.T.		@	°F	@	°F
R_{mc} @ B.H.T.		@	°F	@	°F

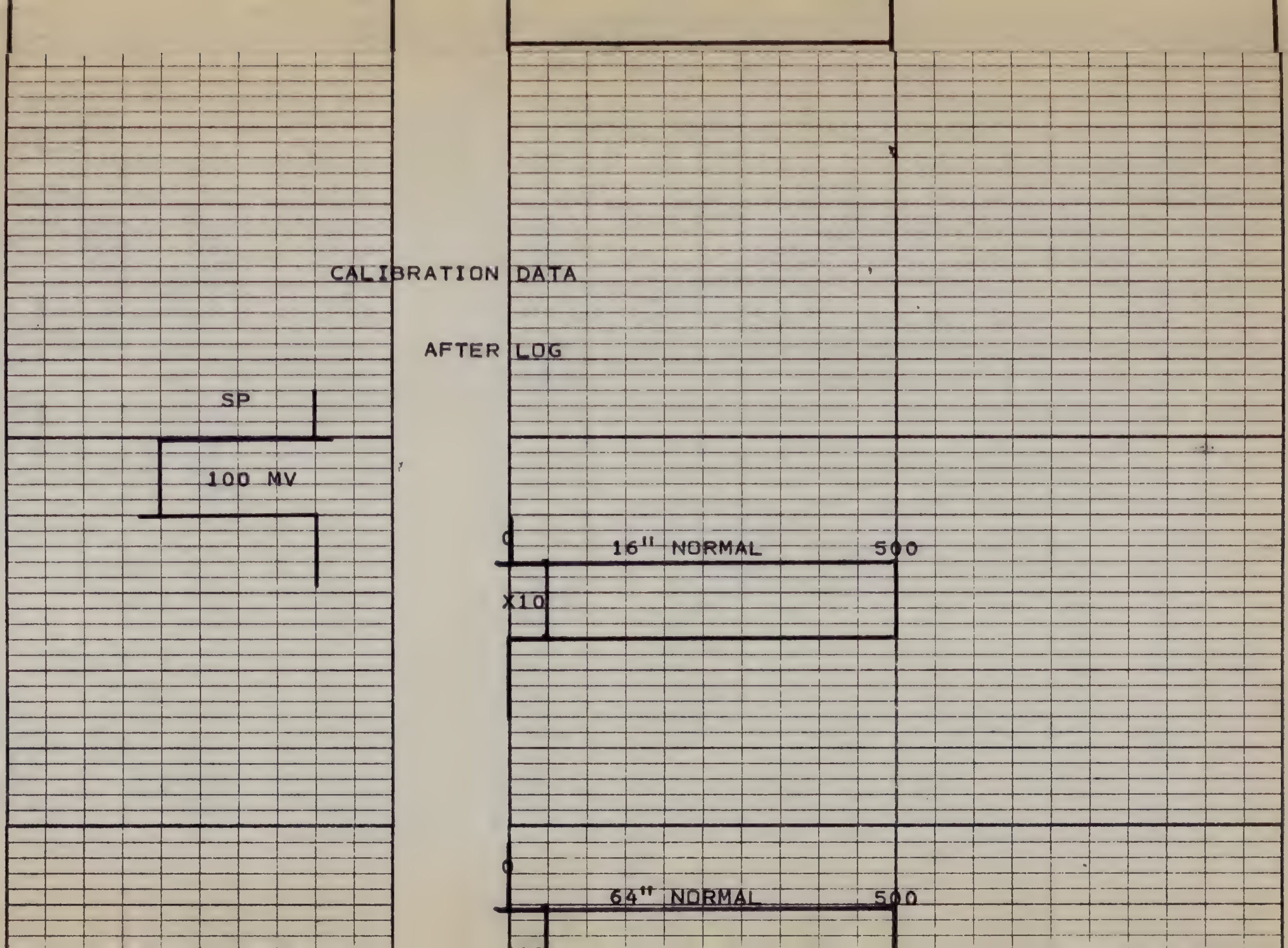
SCALE CHANGES

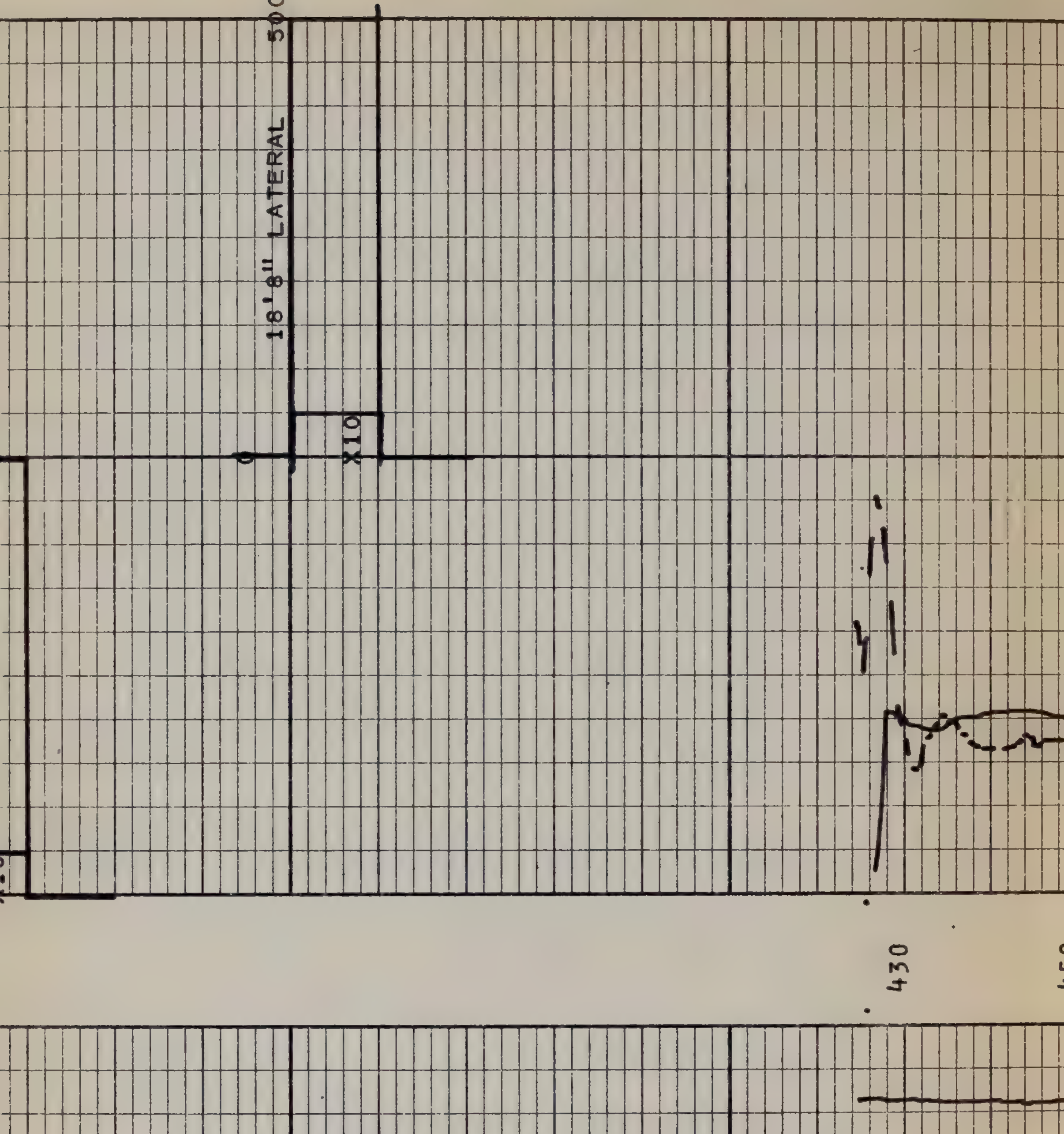
TYPE LOG	DEPTH	SCALE UP HOLE	SCALE DOWN HOLE

EQUIPMENT DATA

RUN NO.	TOOL TYPE	PAD TYPE	TOOL POSITION	OTHER
ONE	E LOG		FREE	

SPONTANEOUS-POTENTIAL MILLIVOLTS	DEPTHS	RESISTIVITY OHMS M^2/M	RESISTIVITY OHMS M^2/M
– 25 +		0 16" NORMAL 500 0 5000 0 64" NORMAL 500	0 18'8" LATERAL 500 0 5000


CALIBRATION DATA
AFTER LOG
SP
100 MV
0
16" NORMAL
500
X10
0
64" NORMAL
500



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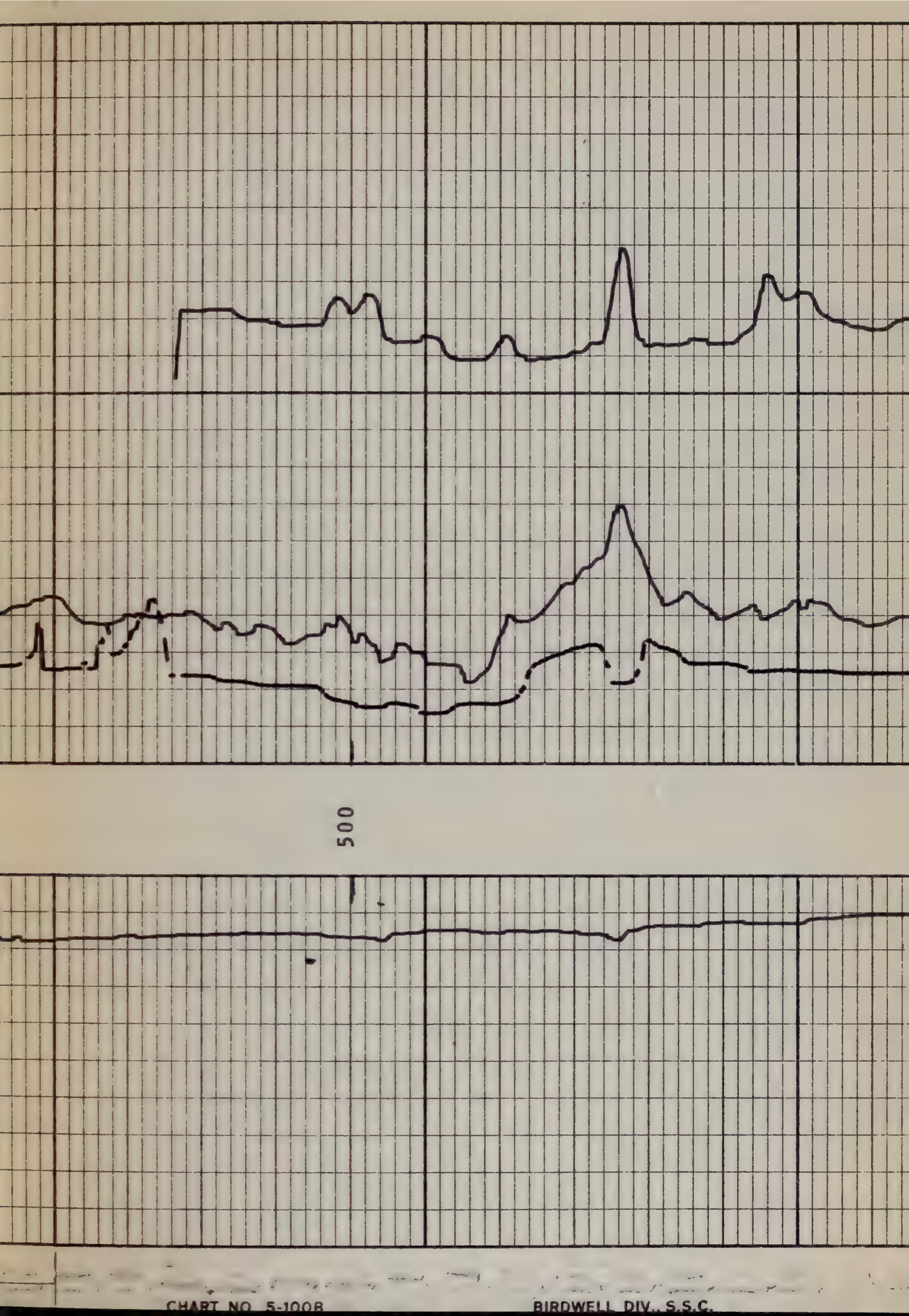
BIRDWELL DIV. S.S.C.
PRINTED IN U.S.A.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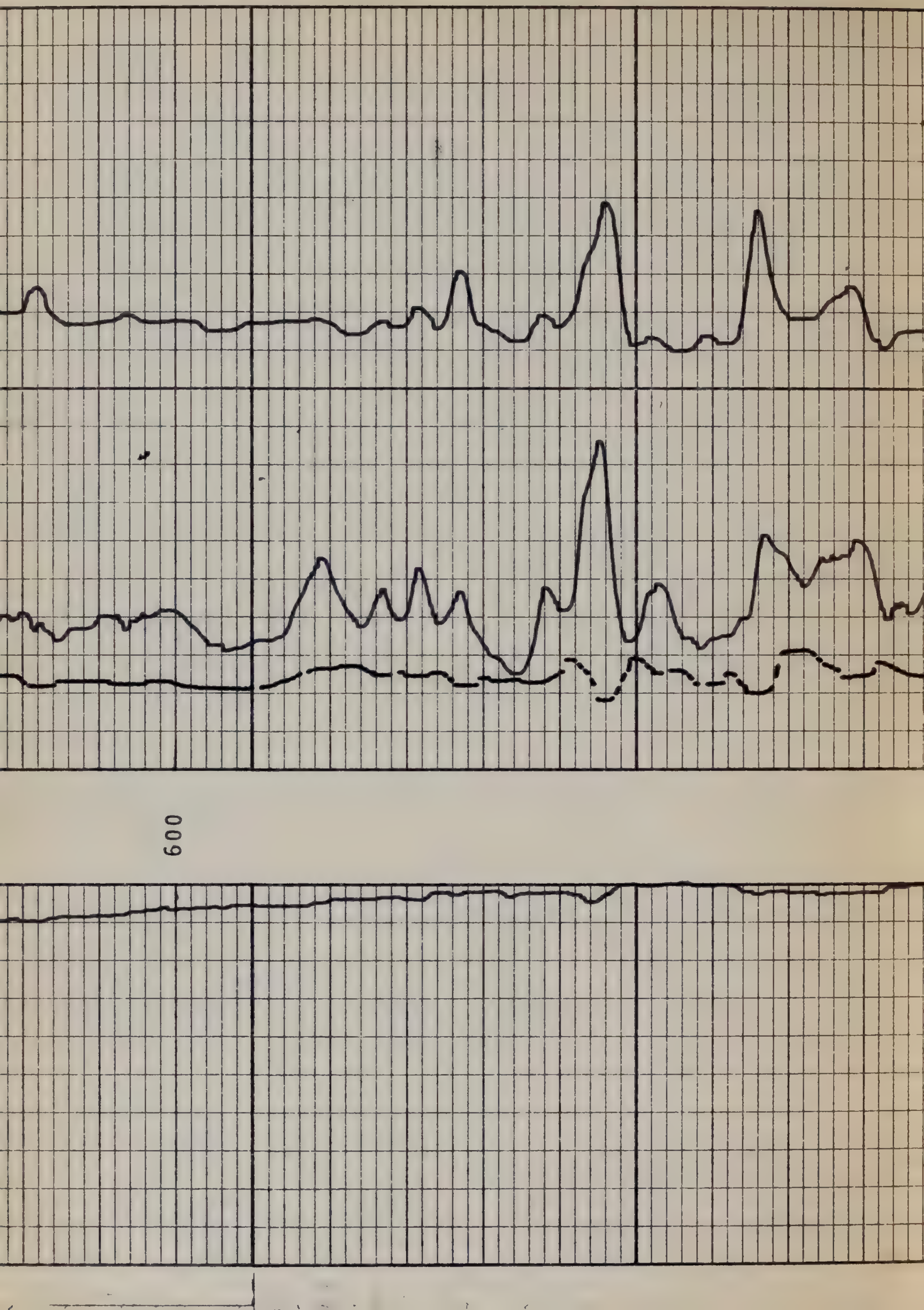
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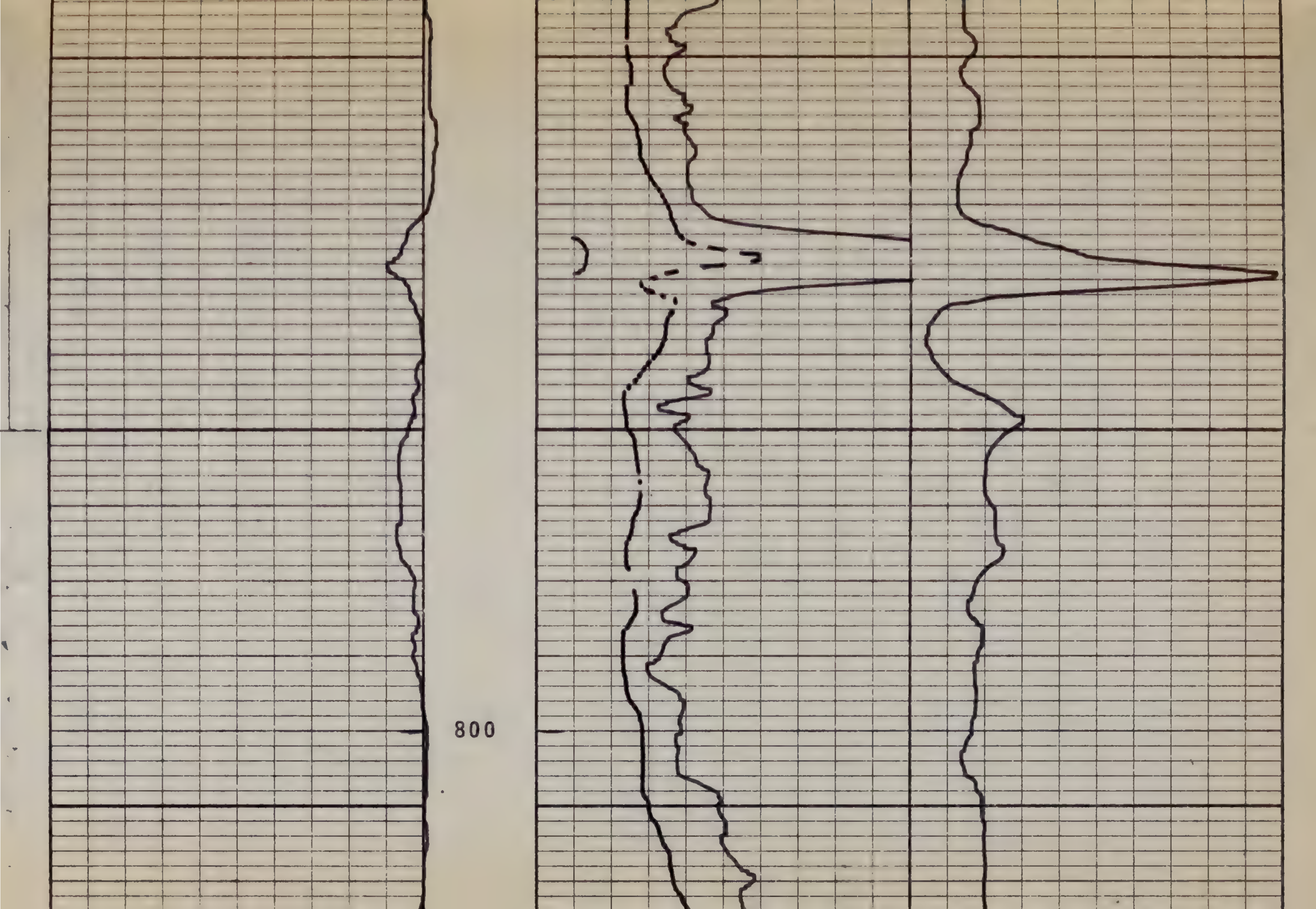
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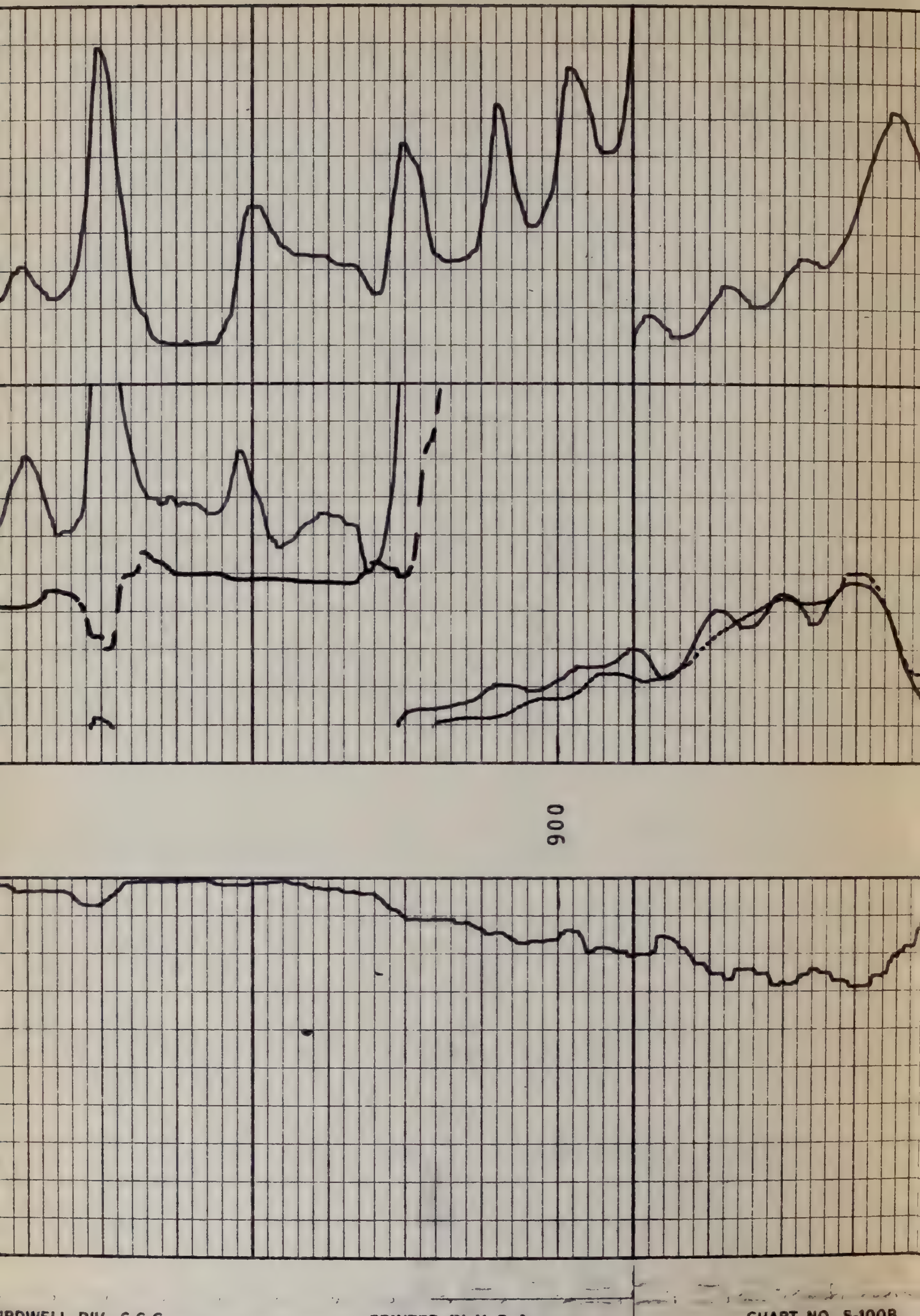
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PRINTED IN U. S. A.
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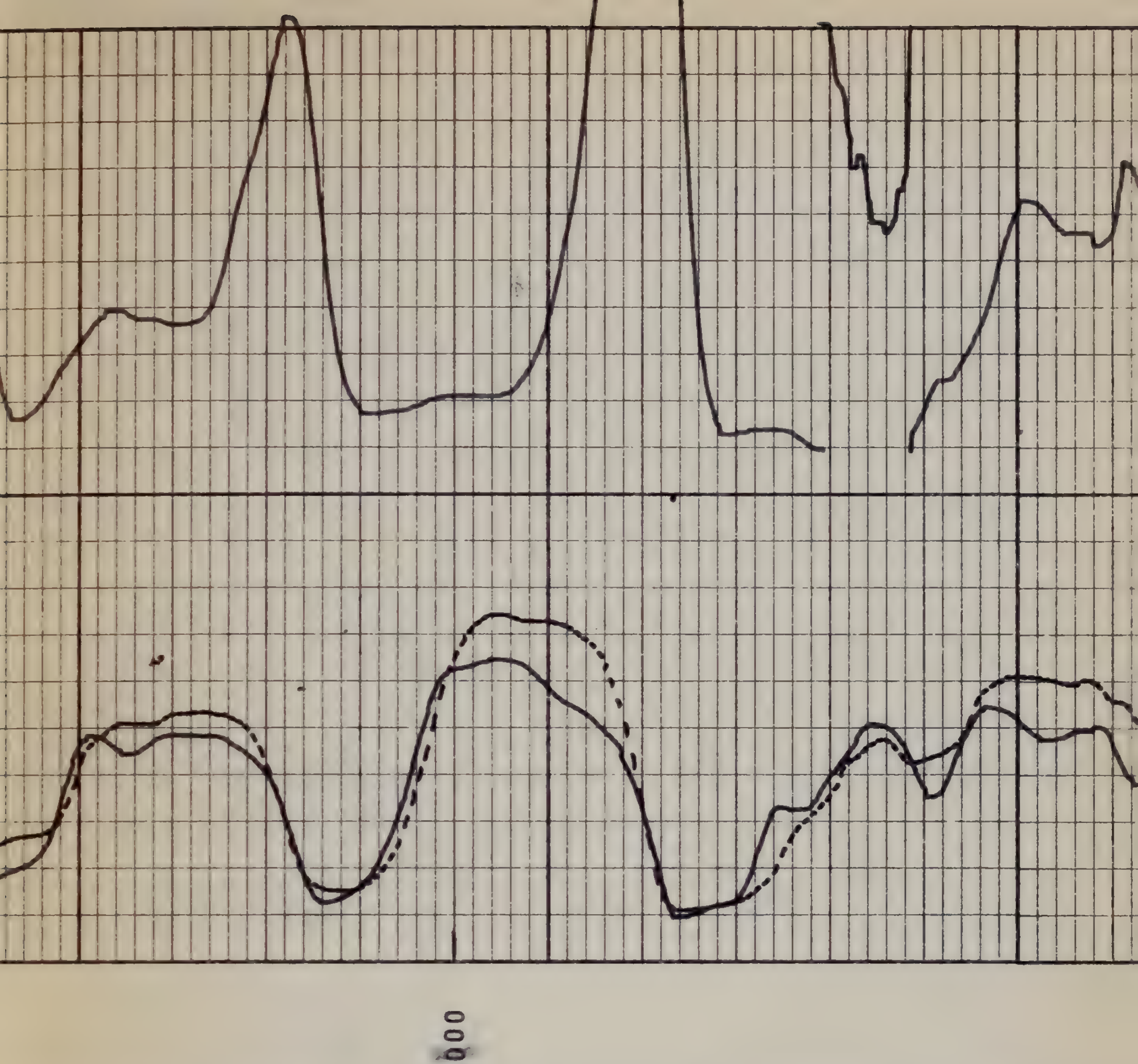
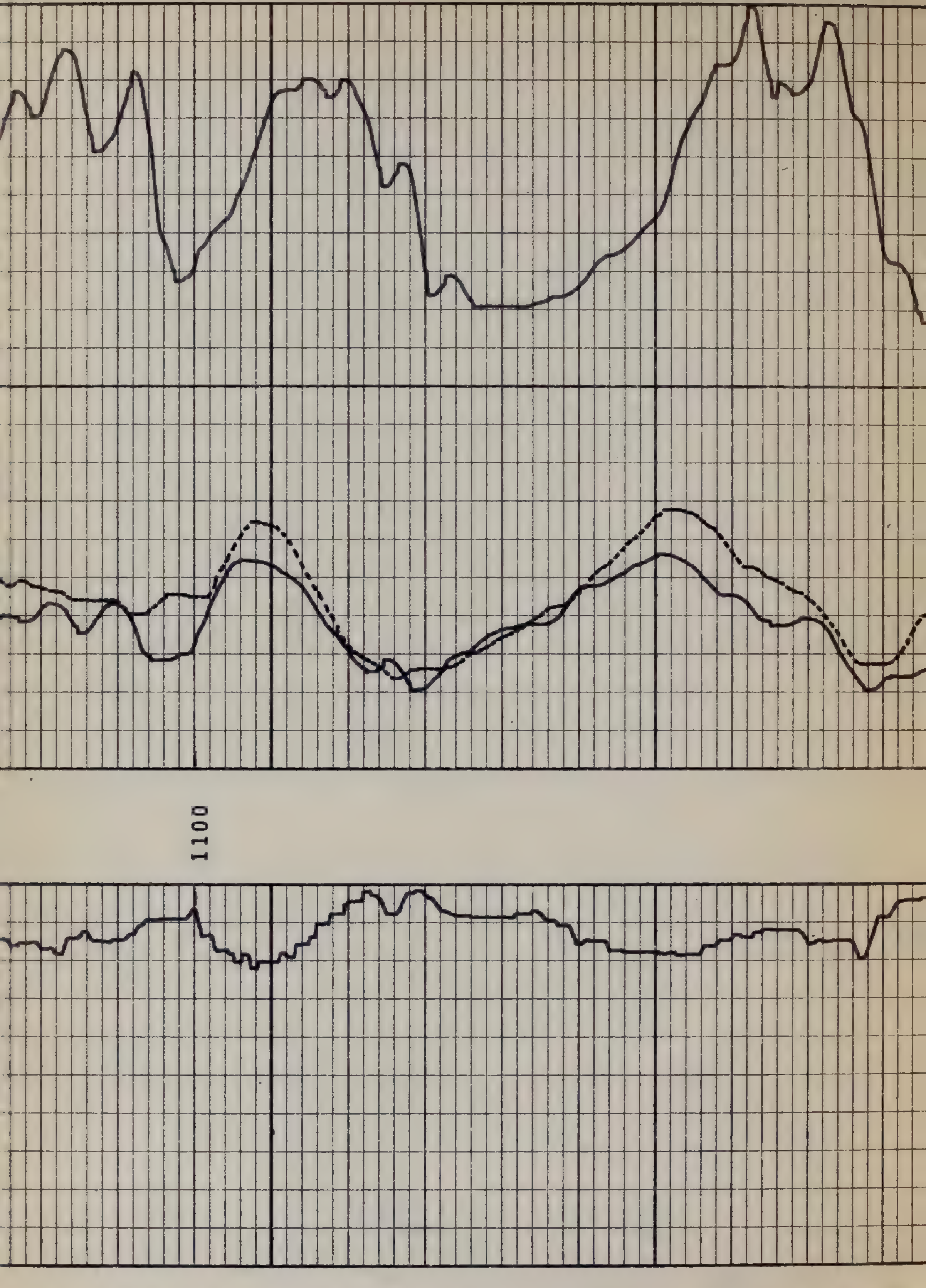


BIRDWELL DIV., S.S.C. PRINTED IN U. S. A.



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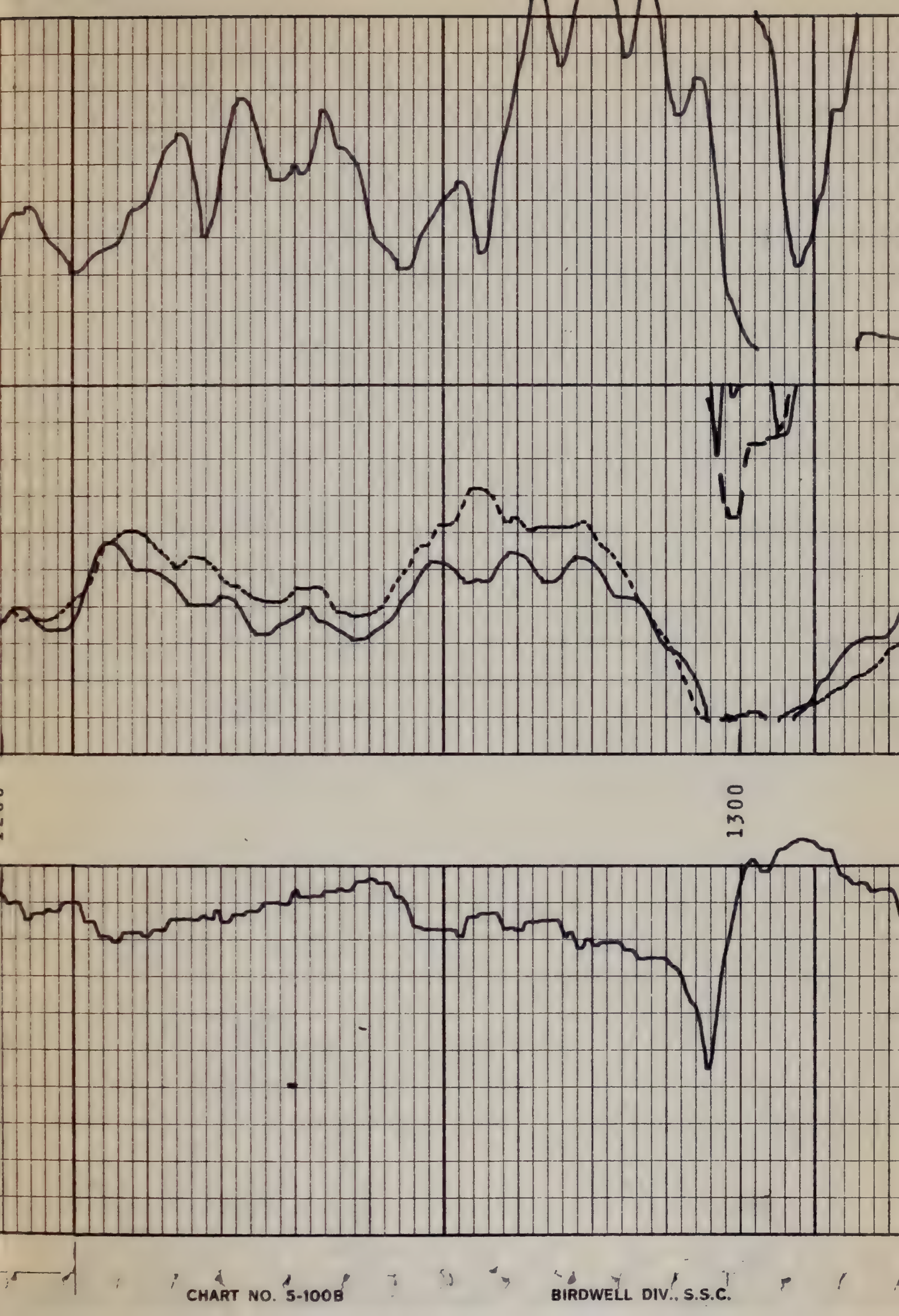
1300
CHART NO. 5-100B
BIRDWELL DIV., S.S.C.

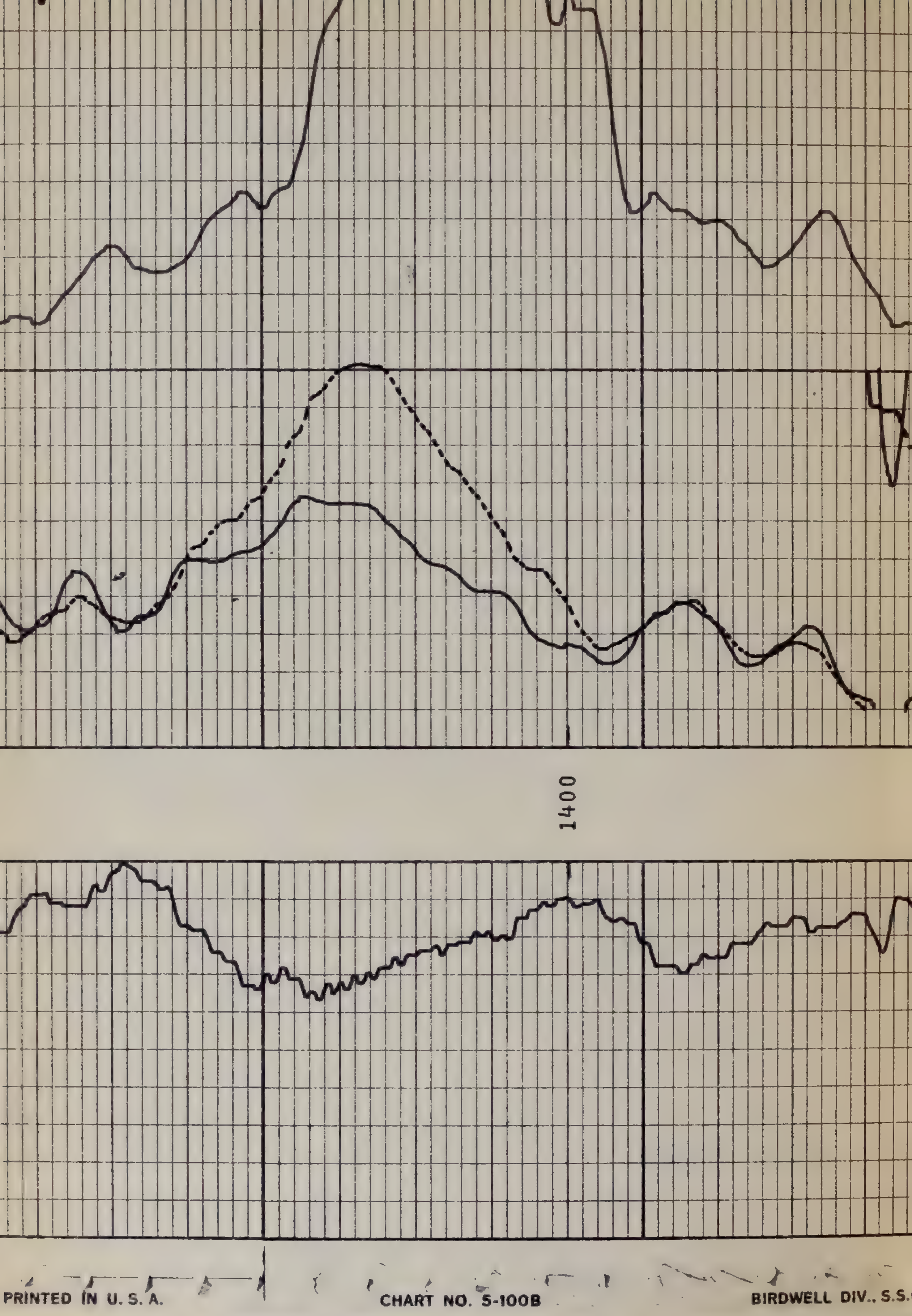
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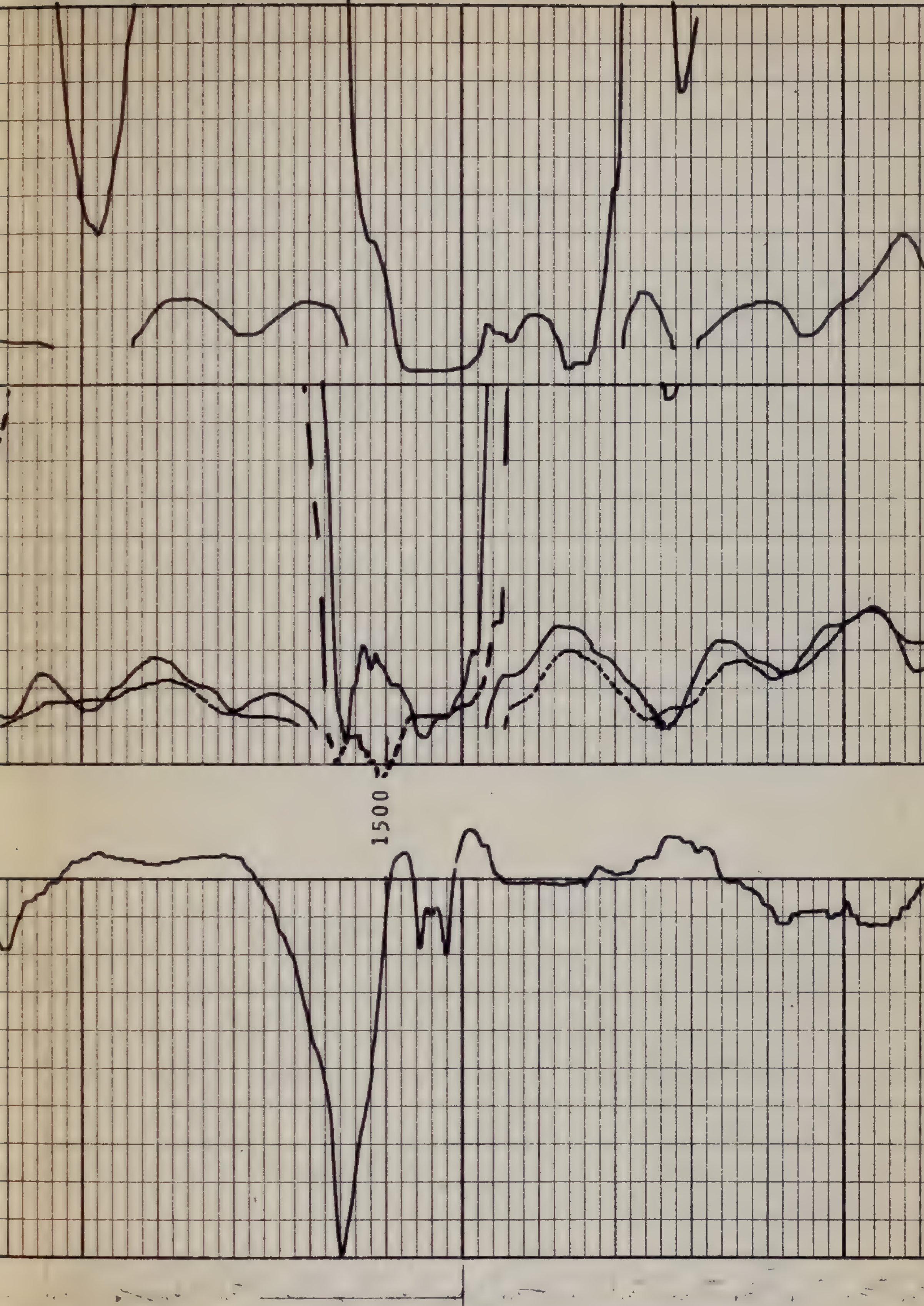
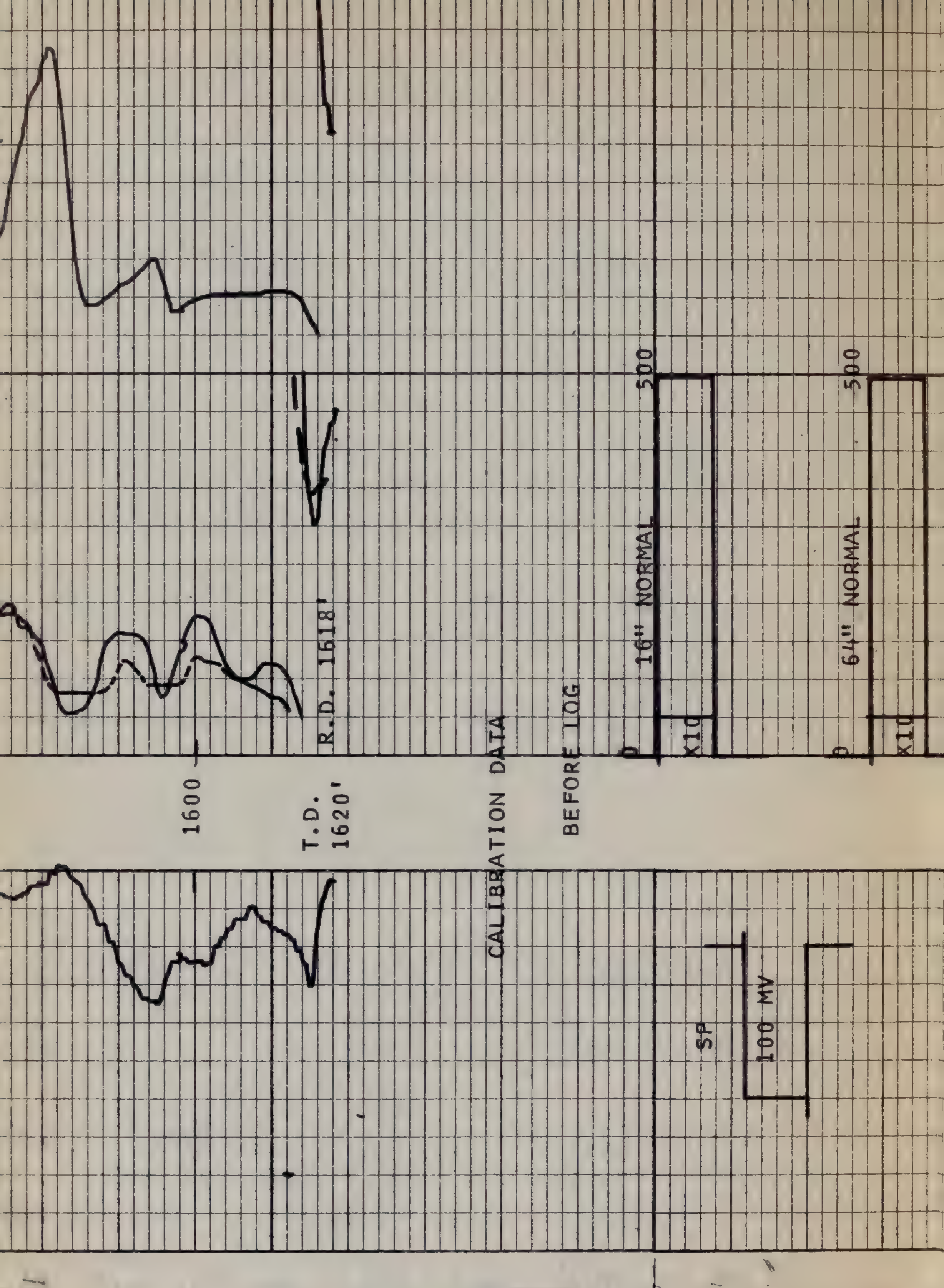
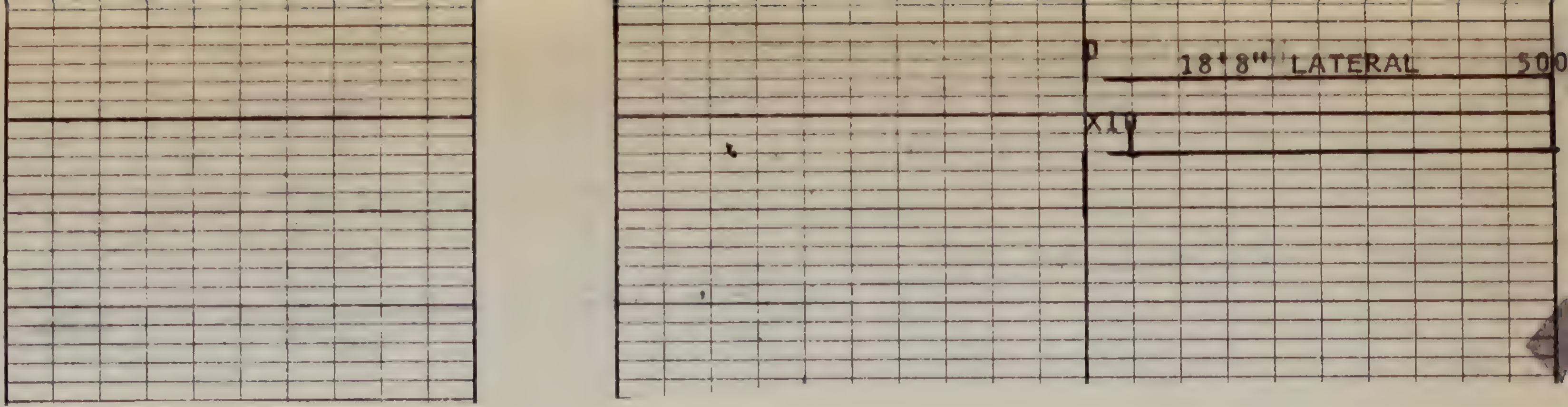
CHART NO. S-100B
BIRDWELL DIV., S.S.



PRINTED IN U. S. A.

CHART NO. 5-100B


R.D. 1618'
1600
T.D. 1620'
CALIBRATION DATA
BEFORE LOG
500
16" NORMAL
0
X10
500
64" NORMAL
0
X10
SP
100 MV



BIRDWELL DIV

Birdwell

Density Log

COMPANY ATLANTIC RICHFIELD COMPANY,
ET. AL.

WELL SORGHUM GULCH AQUIFER TEST #A-1

FIELD

COUNTY RIO BLANCO **STATE** COLORADO

LOCATION:

SEC. 7 **TWP.** 3S **RGE.** 96W

OTHER SERVICES
V3D CAL TL
GR/ENP ES

PERMANENT DATUM GROUND LEVEL, **ELEV.** 6909'
LOG MEASURED FROM GL, ______ **ft. above perm. datum**
DRILLING MEASURED FROM GL

ELEVATIONS:
KB.
DF.
GL. 6909'

DATE	2 JULY 74		
RUN NO.	1		
TYPE LOG	FDL		
DEPTH – DRILLER	1621		
DEPTH – LOGGER	1620		
BOTTOM LOGGED INTERVAL	1618		
TOP LOGGED INTERVAL	50		
TYPE FLUID IN HOLE	WATER		
SALINITY PPM CL.			
DENSITY LB./GAL.			
LEVEL	412		
MAX. REC. TEMP. – DEG. F	78°		
OPERATING RIG TIME	1 HR.		
RECORDED BY	WILSON		
WITNESSED BY	TAIT		
LOCATION	LAS VEGAS		

RUN NO.	**BORE HOLE RECORD**			**CASING RECORD**			
	BIT	**FROM**	**TO**	**SIZE**	**WGT.**	**FROM**	**TO**
1				7"		0	62'
	6-1/4"	62'	1621'				

GAMMA-GAMMA EQUIPMENT DATA

RUN NO.	1			TOOL SPACING	19"		
TOOL MODEL NO.	LAHD			SOURCE NO.	V-476		
TOOL SERIAL NO.	W-11			DIRECT ZERO LOC.			
DIAMETER	3-5/8"			DISTANCE D OR D′	13"		
SUB	PB			NOMINAL HOLE DIAM.	6-1/4"		
DETECT. MODEL NO.	9371 TN			TRUCK NO.	2694		

GAMMA-GAMMA LOGGING DATA

RUN NO.	DEPTHS FROM	DEPTHS TO	SPEED FT./MIN.	TC SEC.	CPM FULL SCALE	DIRECT CPM /DIV.	LINEAR GMS./DIV.
1	1618'	50'	20	3	$10X10^4$		.05

PRIMARY REFERENCE	A-14	M-107
EQUIVALENT DEN. G/CC	2.605	1.747
SECONDARY REF.		
EQUIVALENT DEN. G/CC		
KCPM BEFORE LOG		
KCPM AFTER LOG		
RECORDER CAL. REF.	25K	50K
EQUIVALENT DEN. G/CC	2.36	2.07

REMARKS: THIS WORK WAS PERFORMED UNDER UNITED STATES ATOMIC ENERGY COMMISSION BY-PRODUCT MATERIAL LICENSE NO. 35-5651-1

GRAIN DENSITY GMS/CC:

FLUID DENSITY GMS/CC:

NA: INFORMATION NOT AVAILABLE

NOTE: RECORDED BULK DENSITY MUST BE CORRECTED FOR STANDOFF (PROXIMITY INDEX)

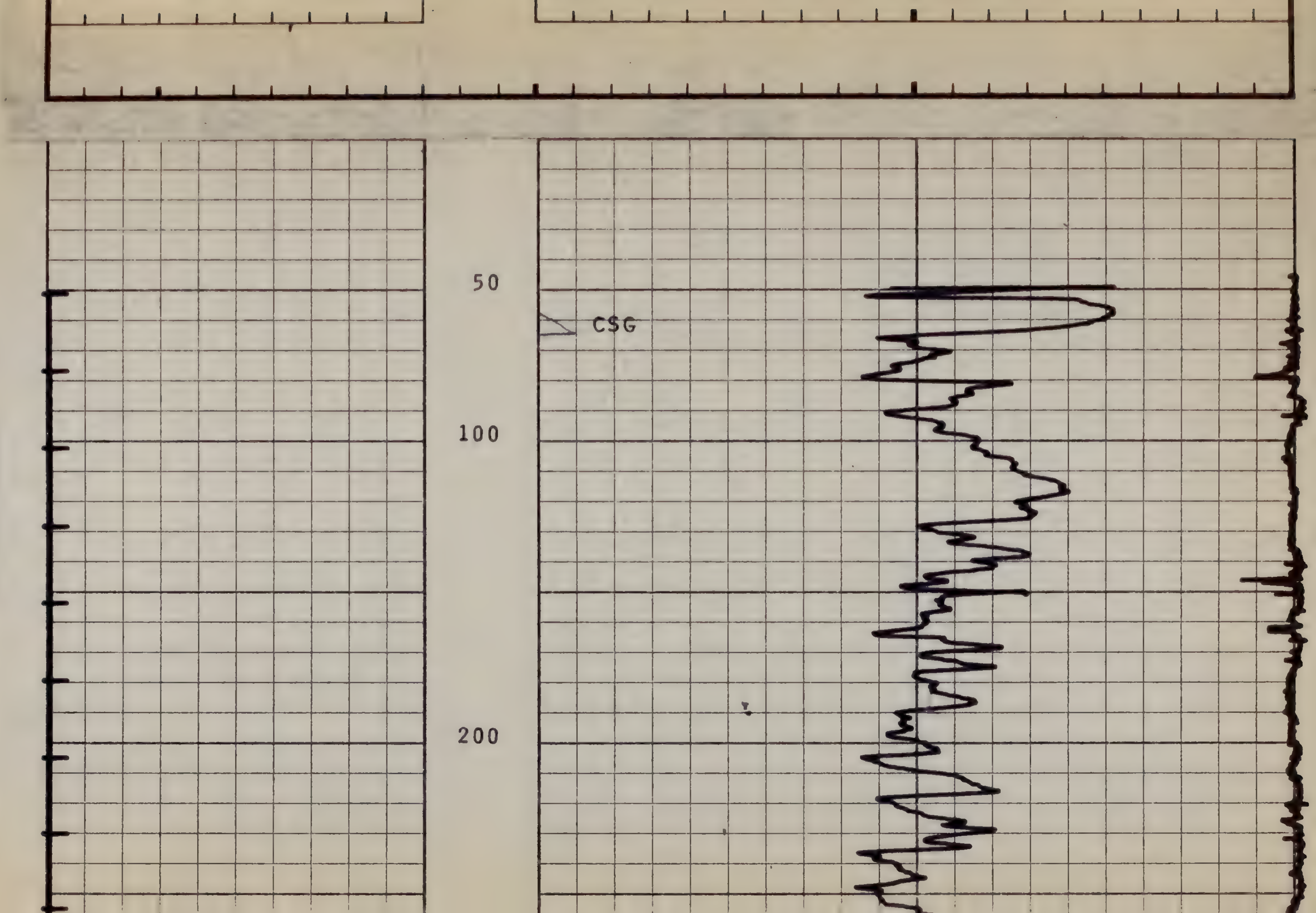
DEPTH

BULK DENSITY
GRAMS/CC

1.6 2.1 2.6

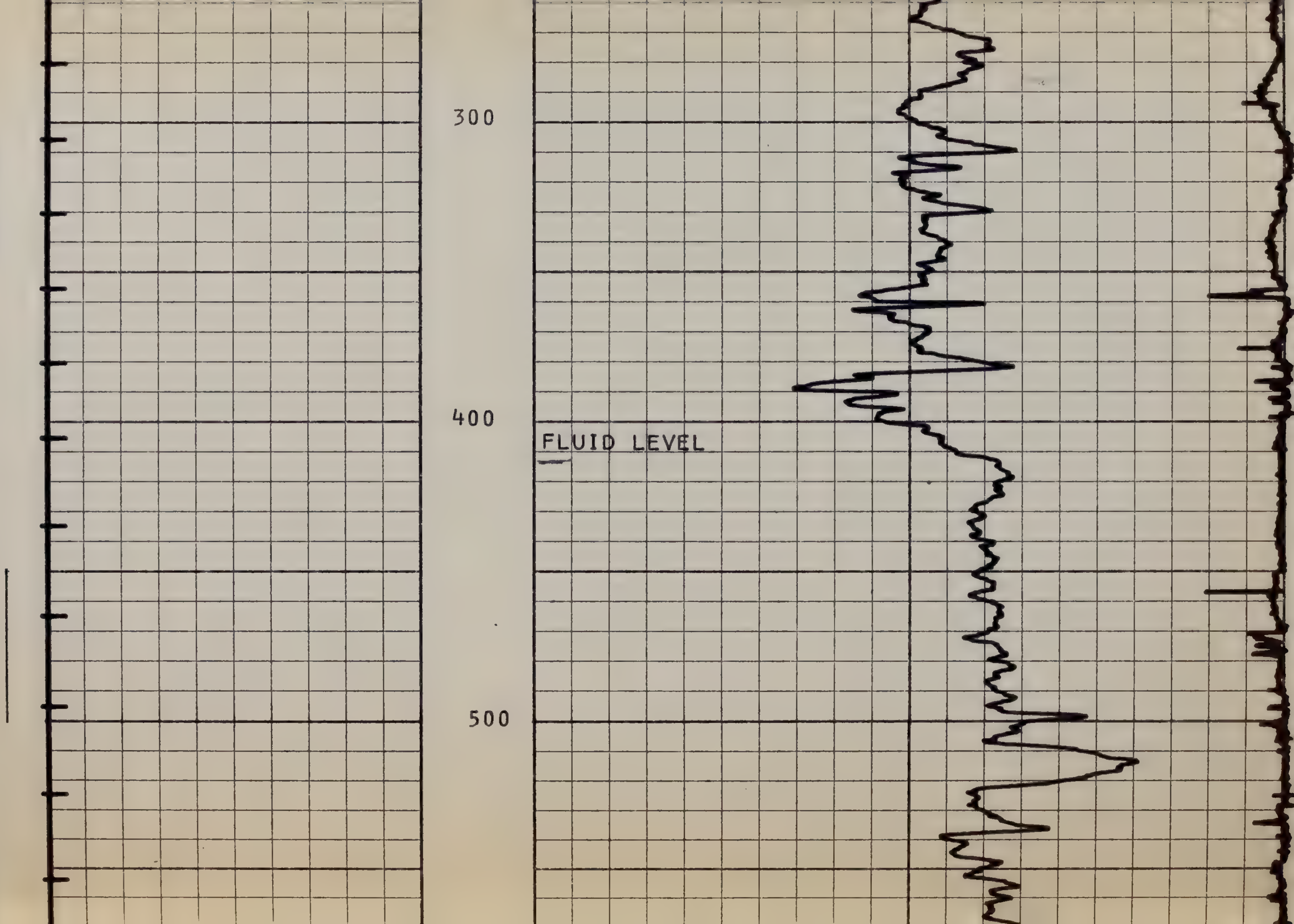
DIRECT COUNT RATE KCPM

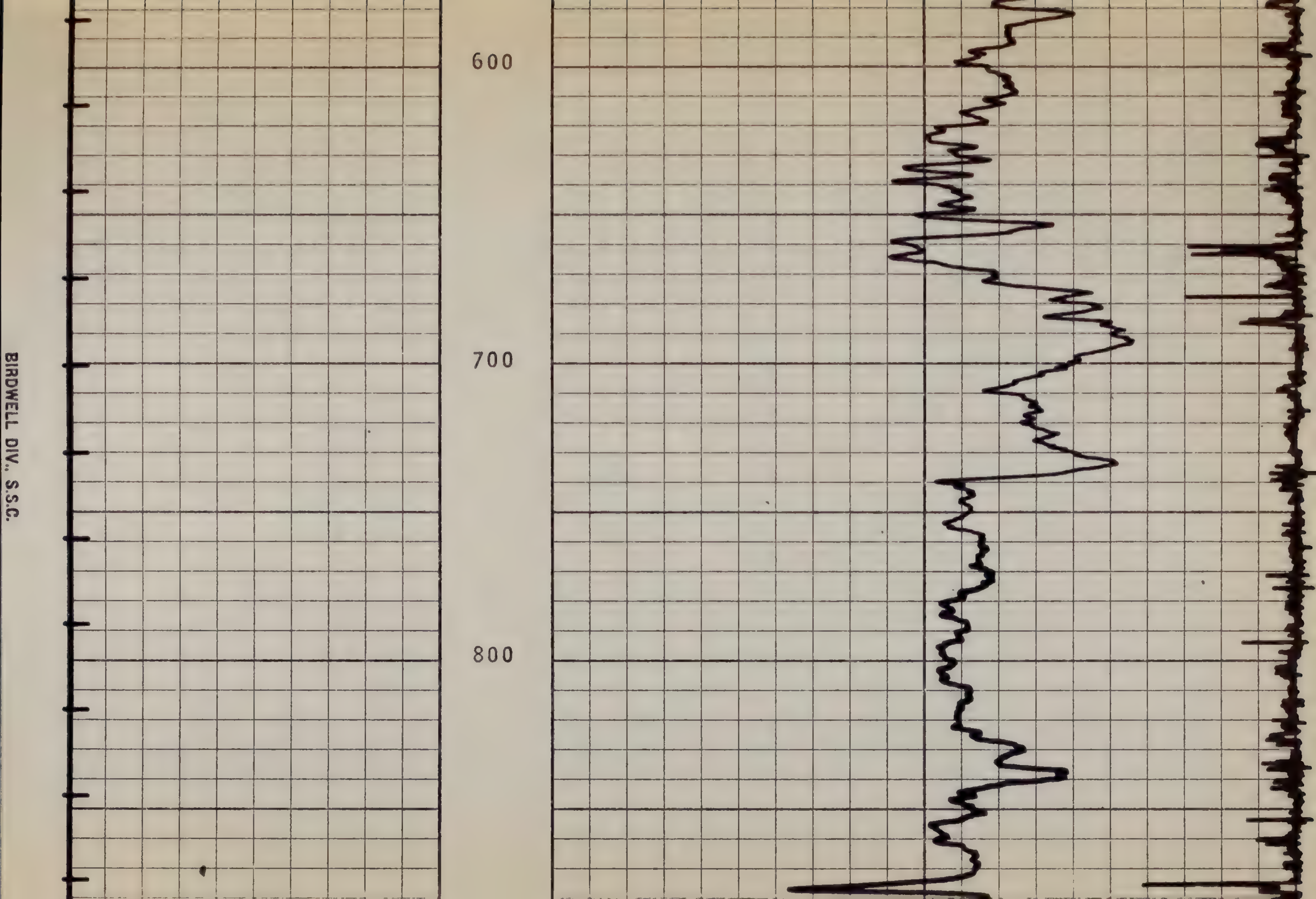
PROXIMITY INDEX
INCHES
1 0



BIRDWELL DIV., S.S.C.

CHART NO. 2-100B




600
700
800
BIRDWELL DIV., S.S.C.

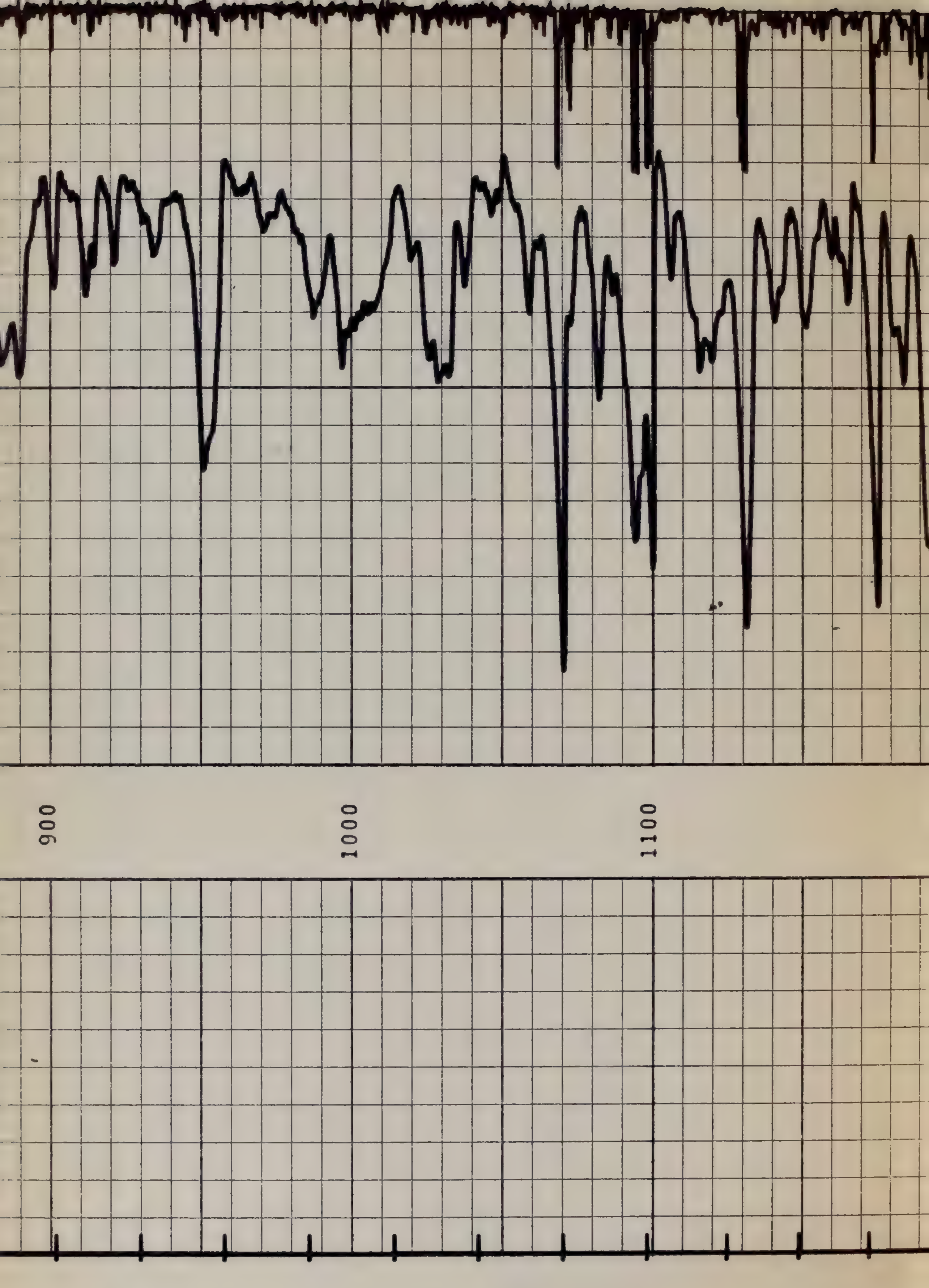
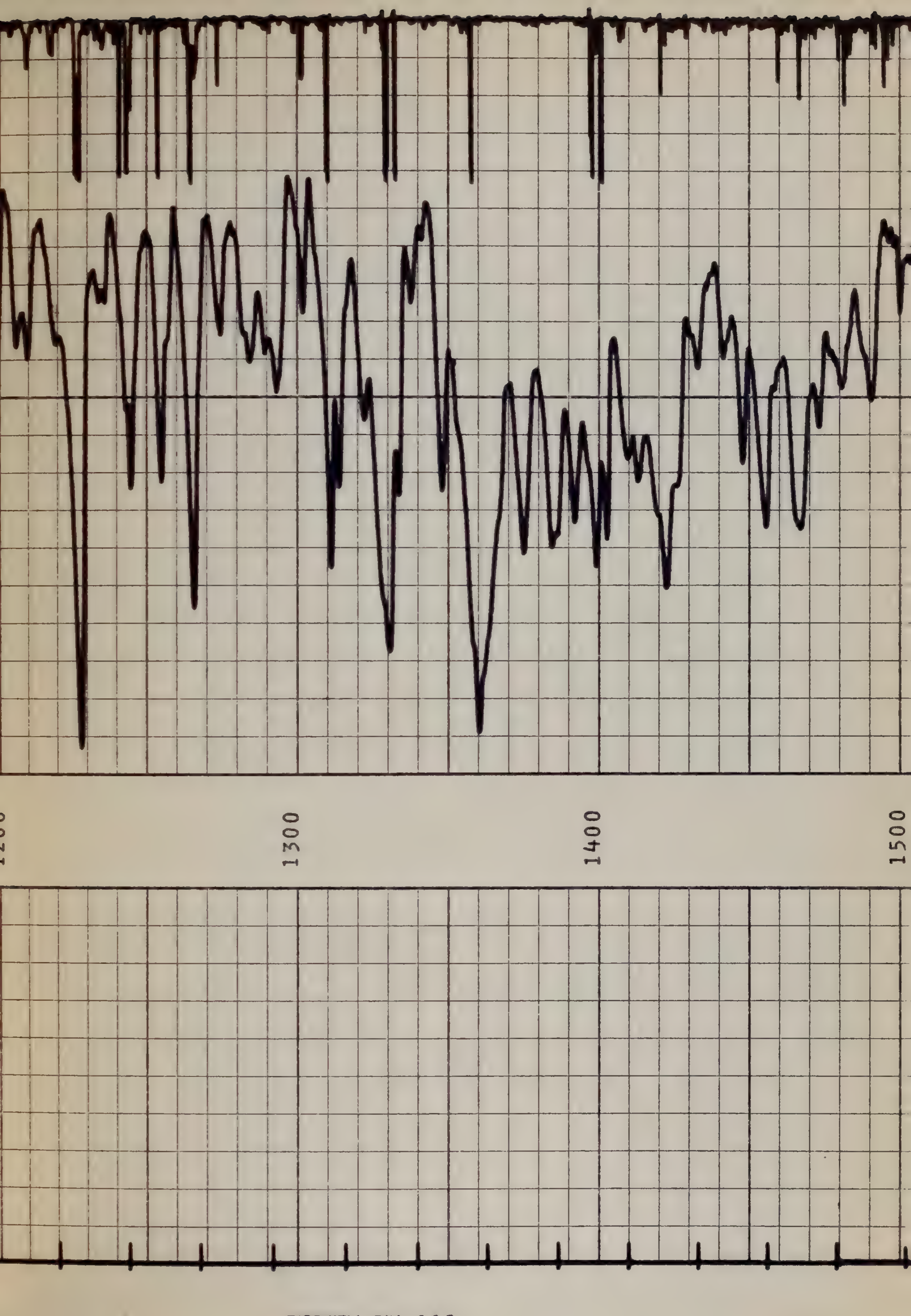
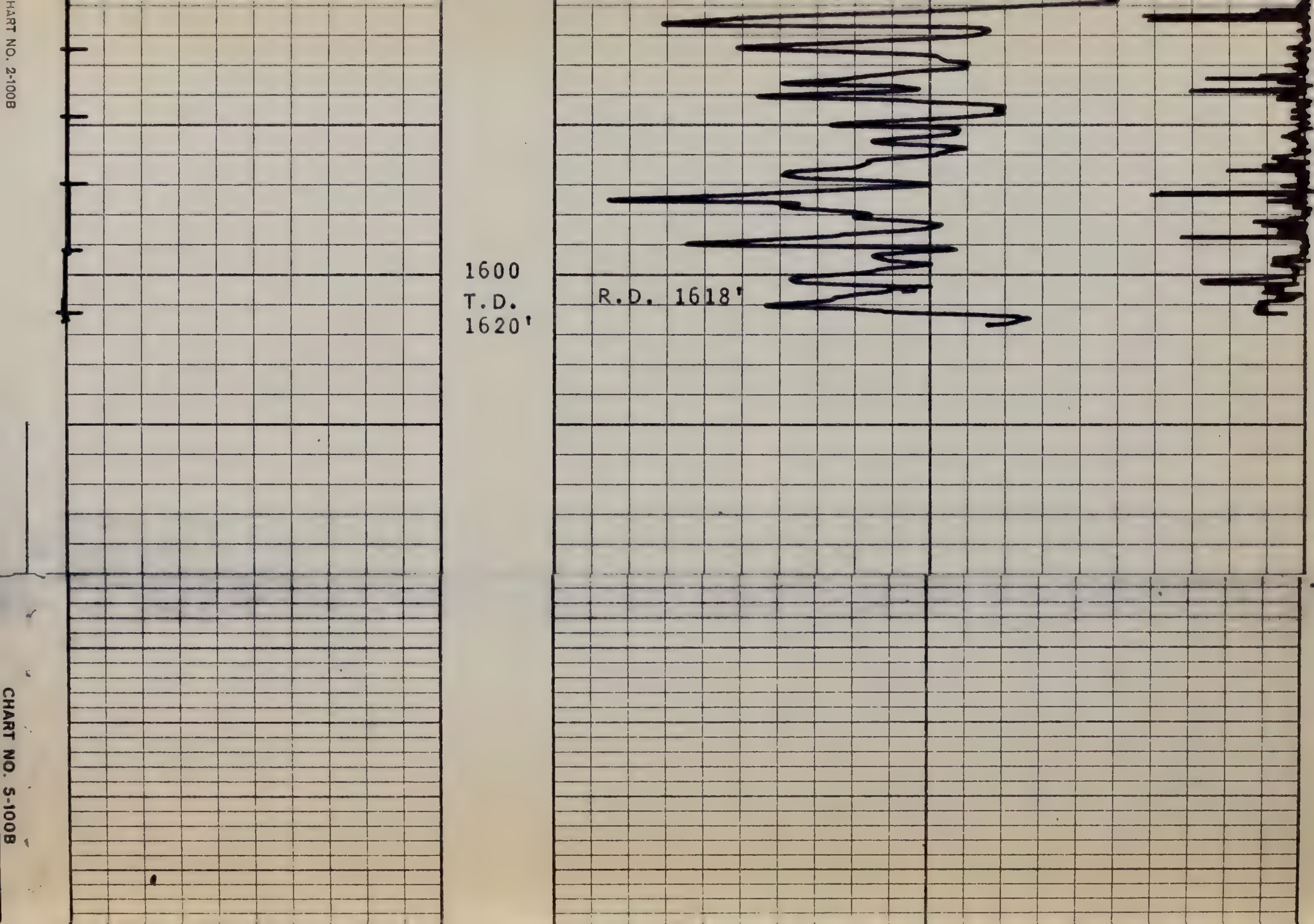
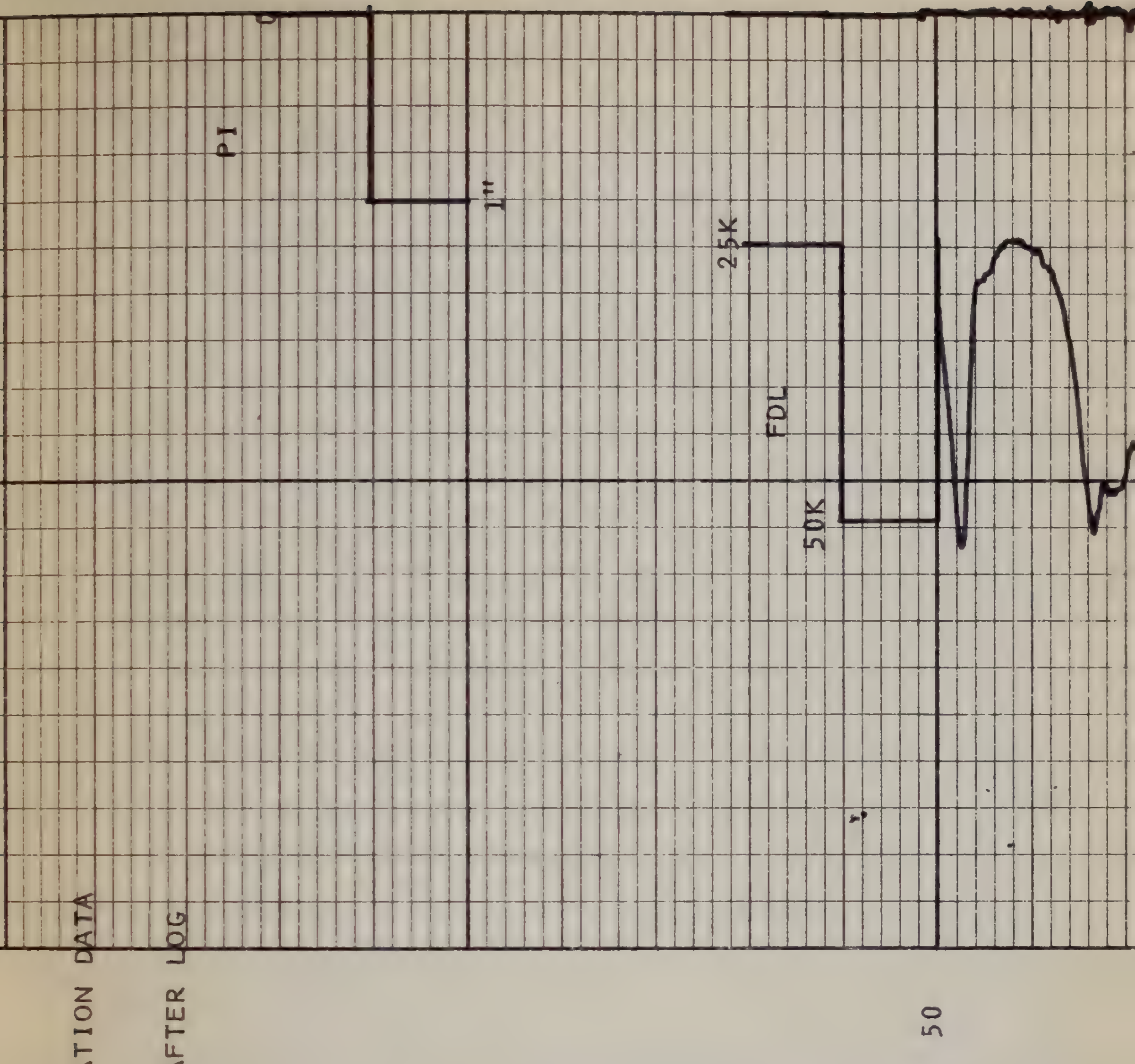


CHART NO. 2-100B



BIRDWELL DIV., S.S.C.

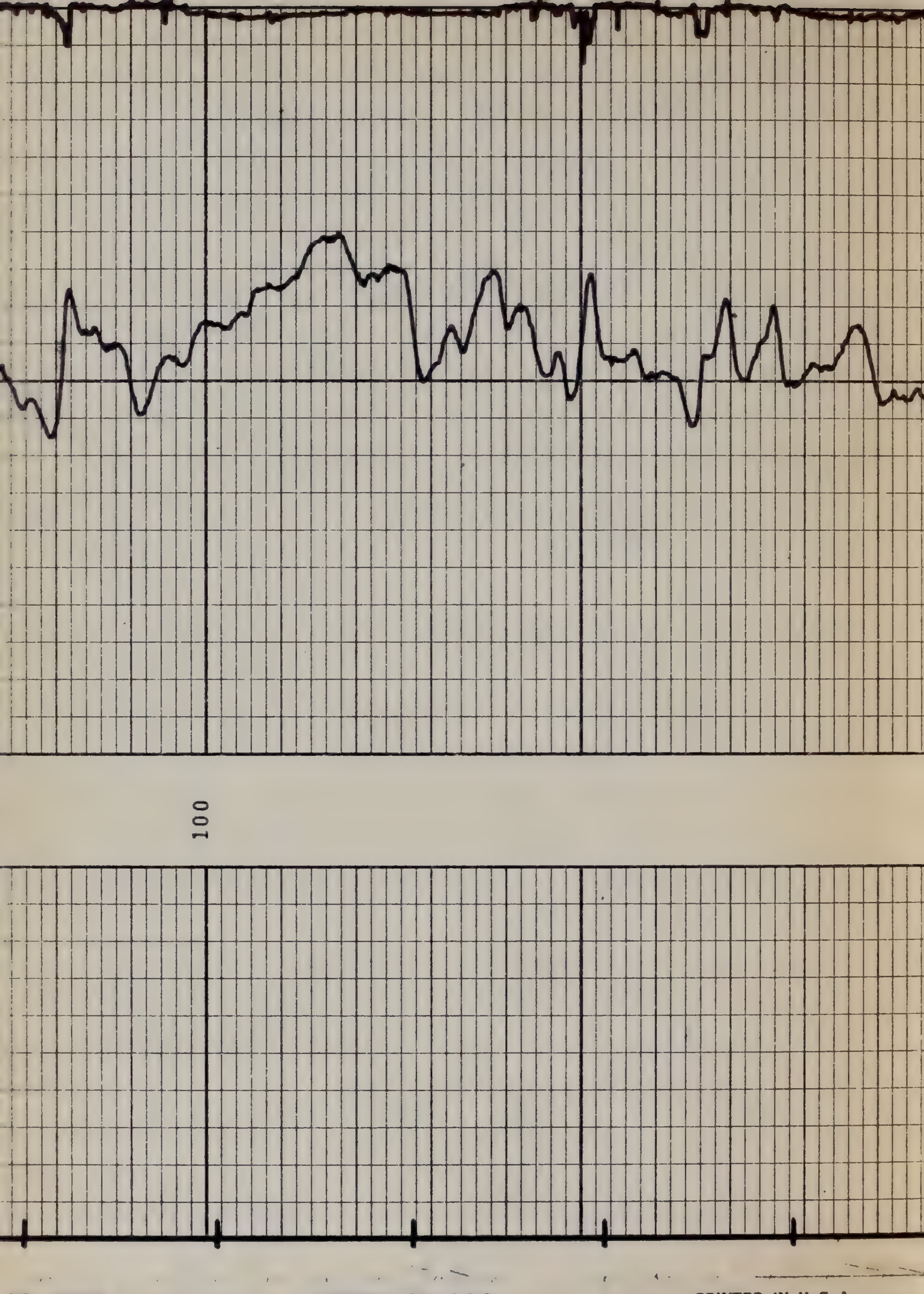

1600
T.D.
1620'
R.D. 1618'
HART NO. 2-100B
CHART NO. 5-100B



BIRDWELL DIV., S.S.C.

PRINTED IN U. S. A.

CHAR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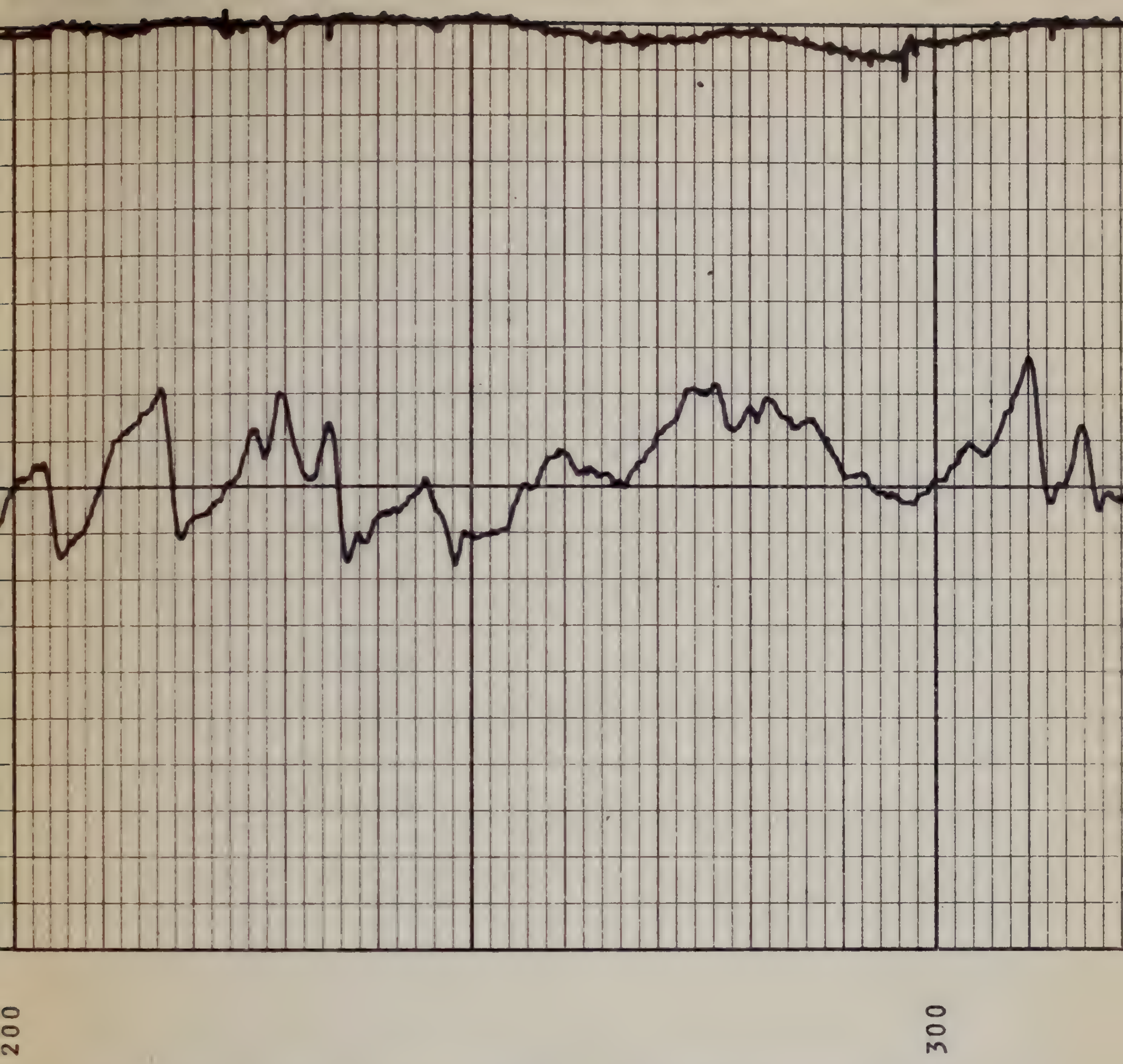
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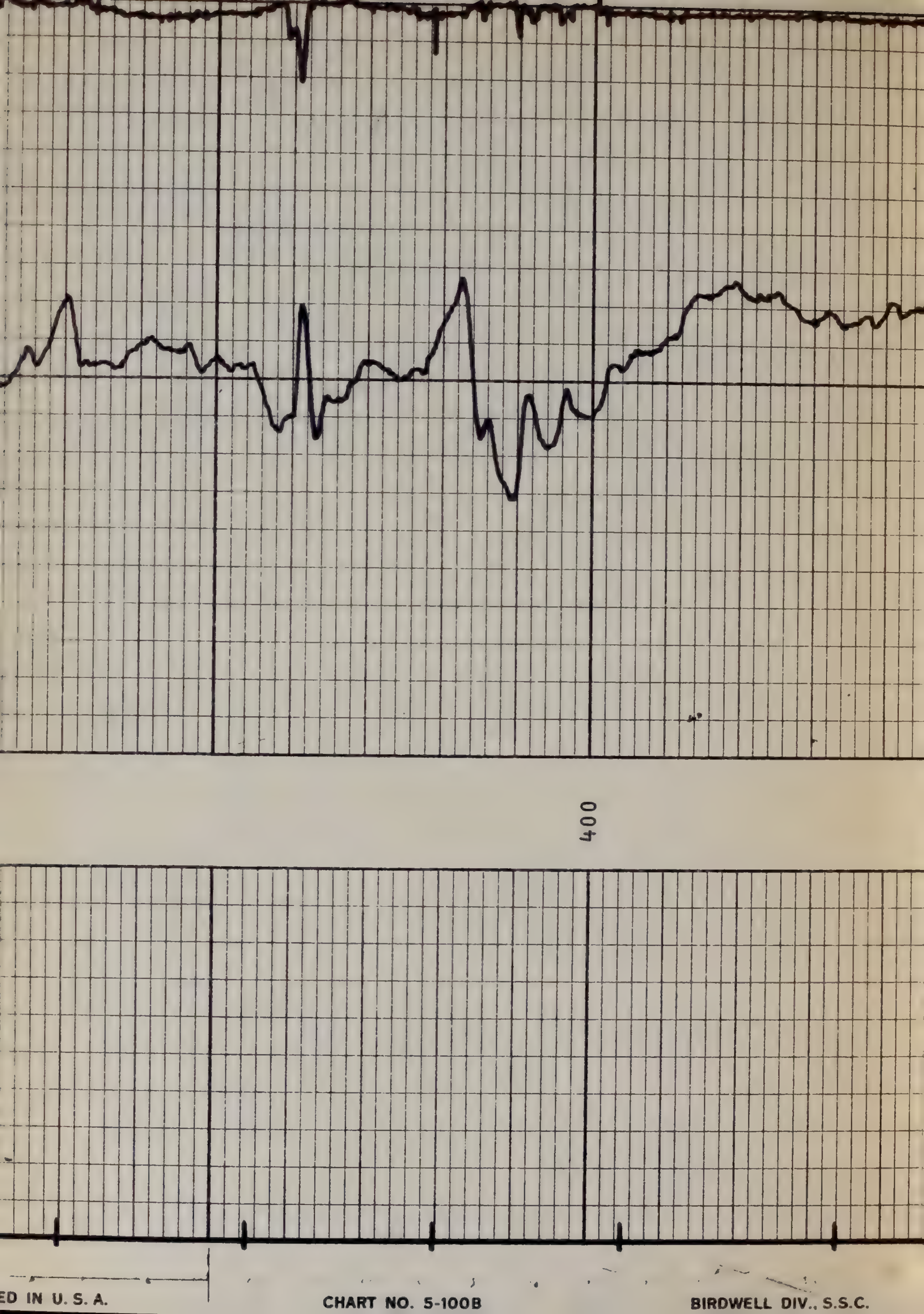
300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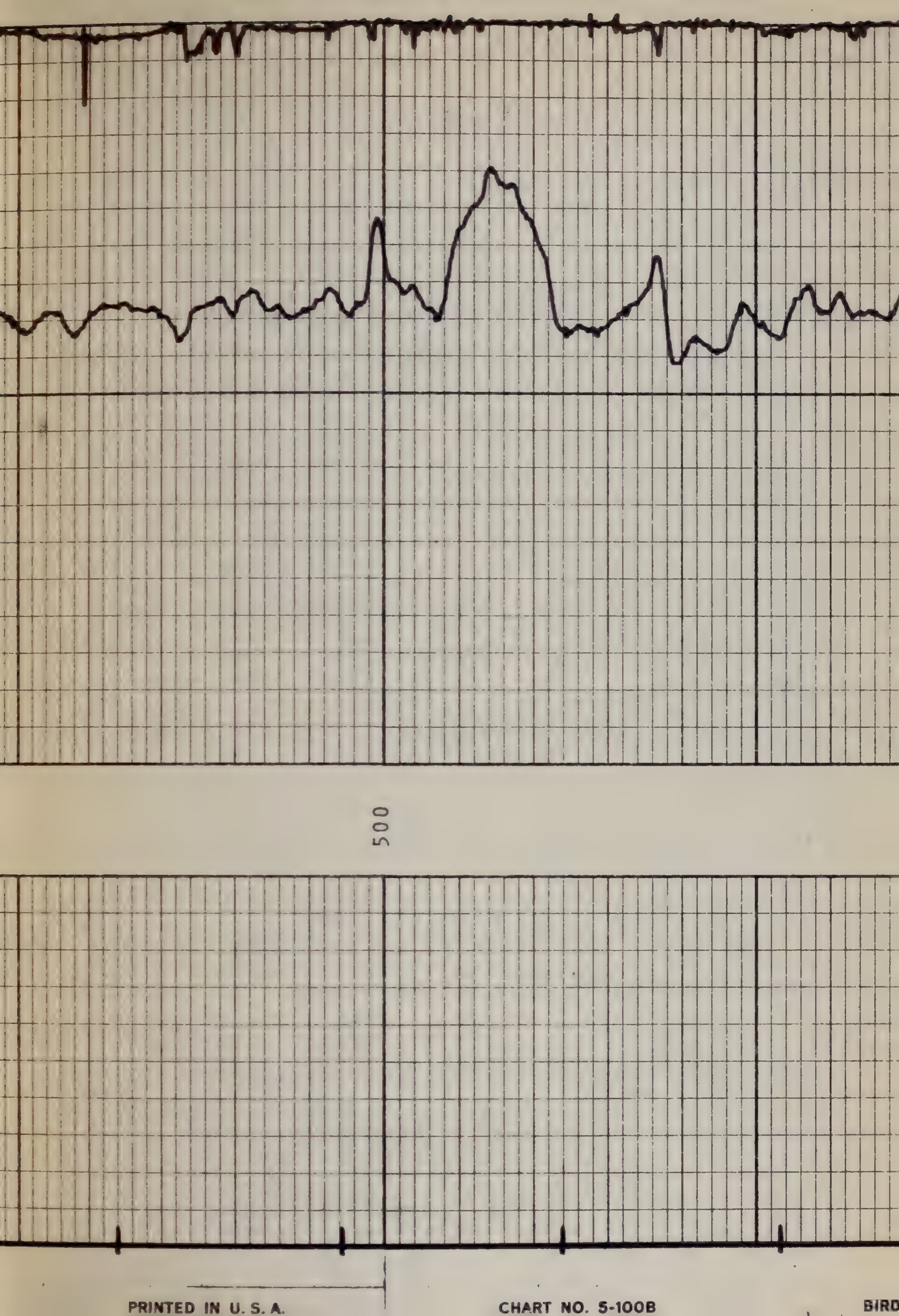
ED IN U. S. A.
CHART NO. 5-100B
BIRDWELL DIV., S.S.C.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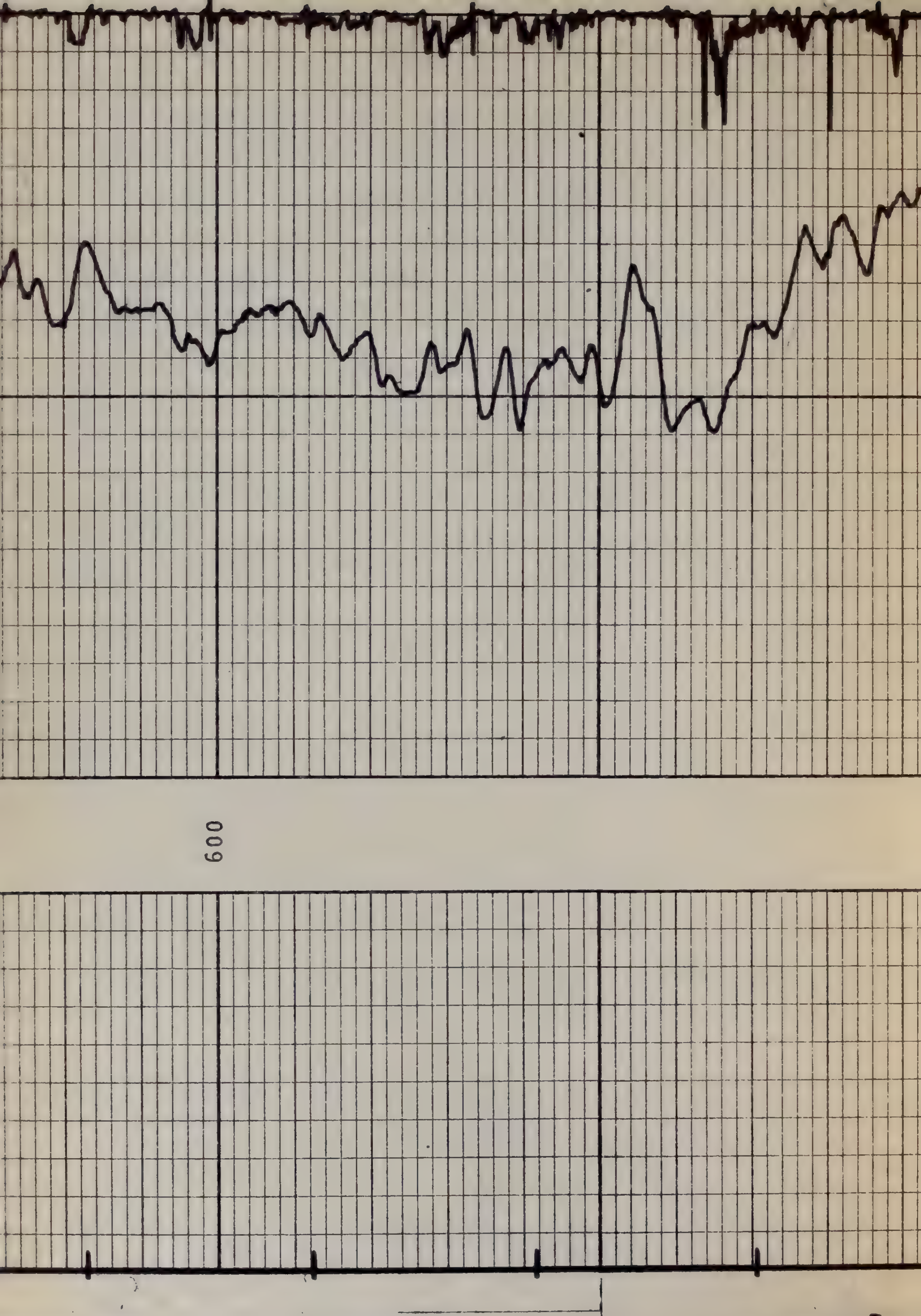
PRINTED IN U. S. A.
CHART NO. 5-100B
BIRD



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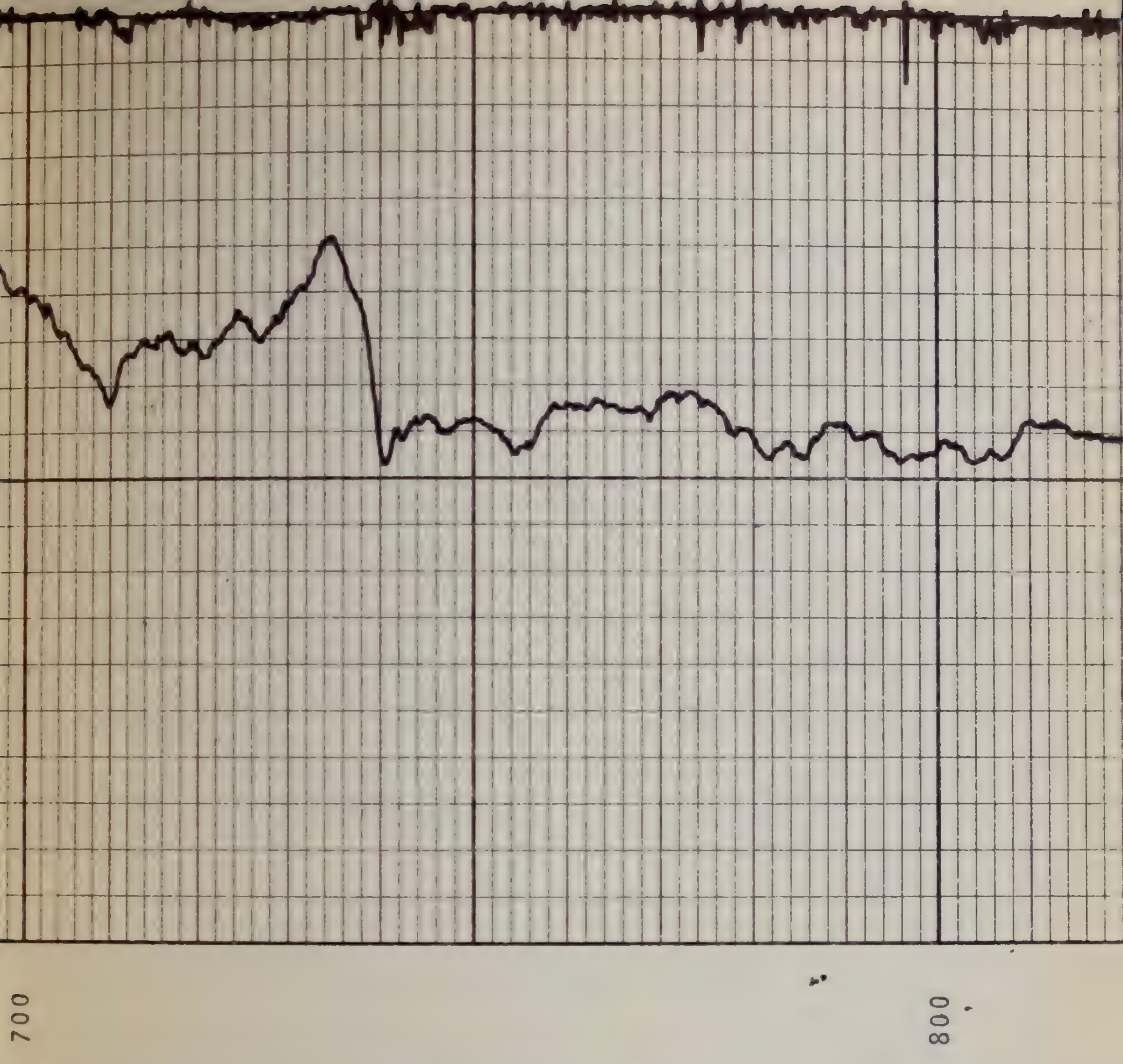
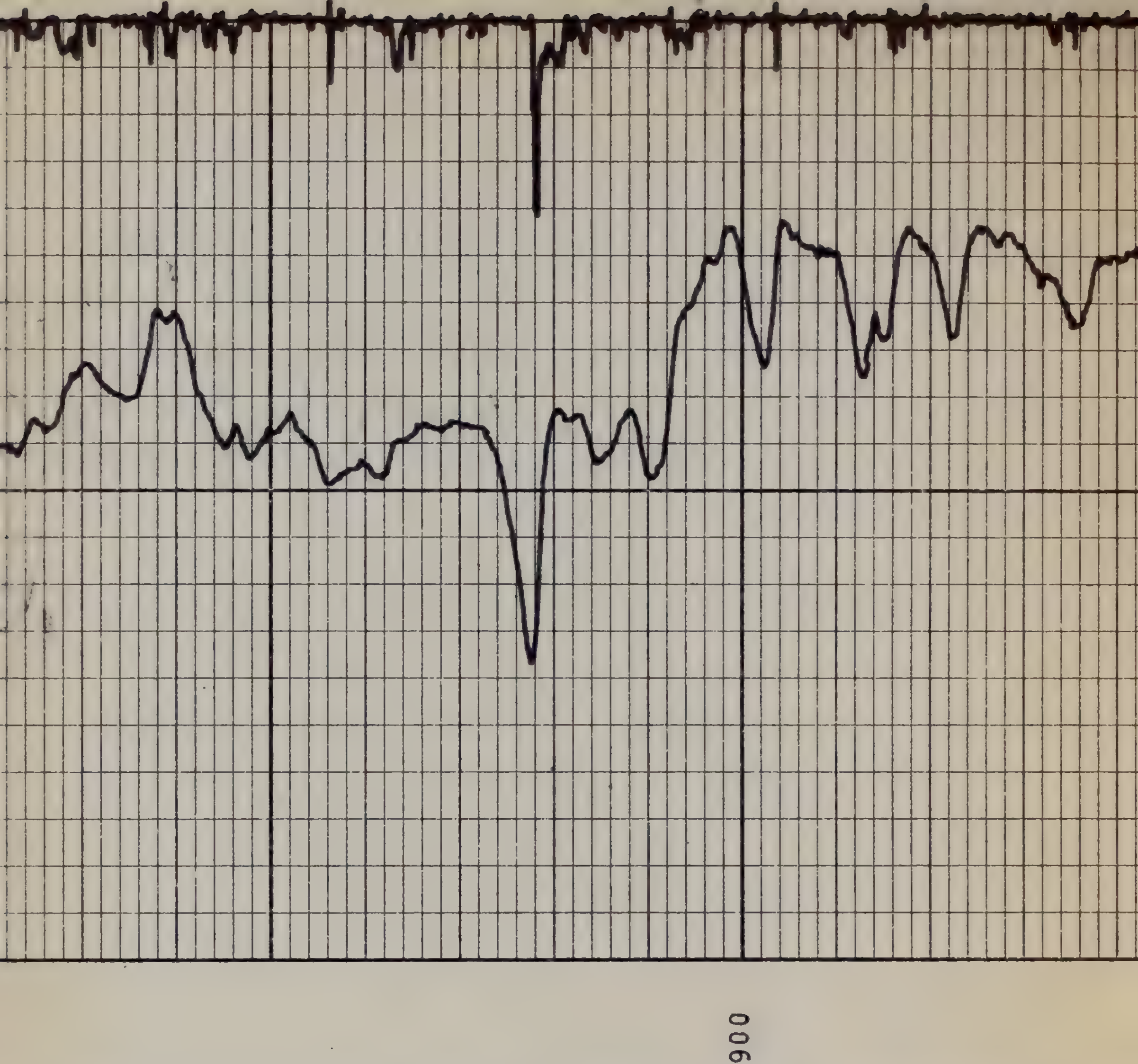


BIRDWELL DIV., S.S.C. PRINTED IN U. S. A. CHA



T NO. 5-100B BIRDWELL DIV., S.S.C. PRINTED IN U. S. A.

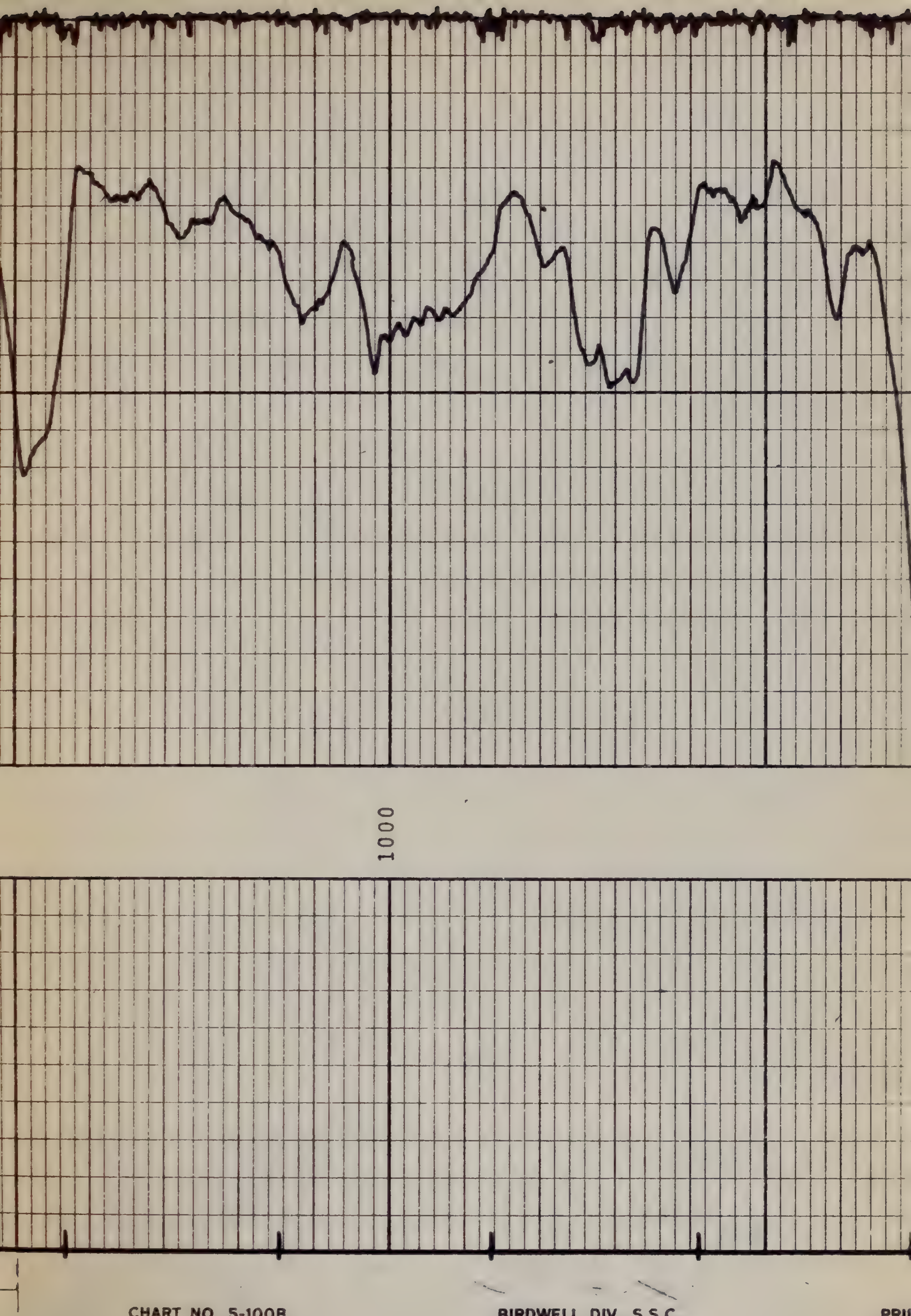

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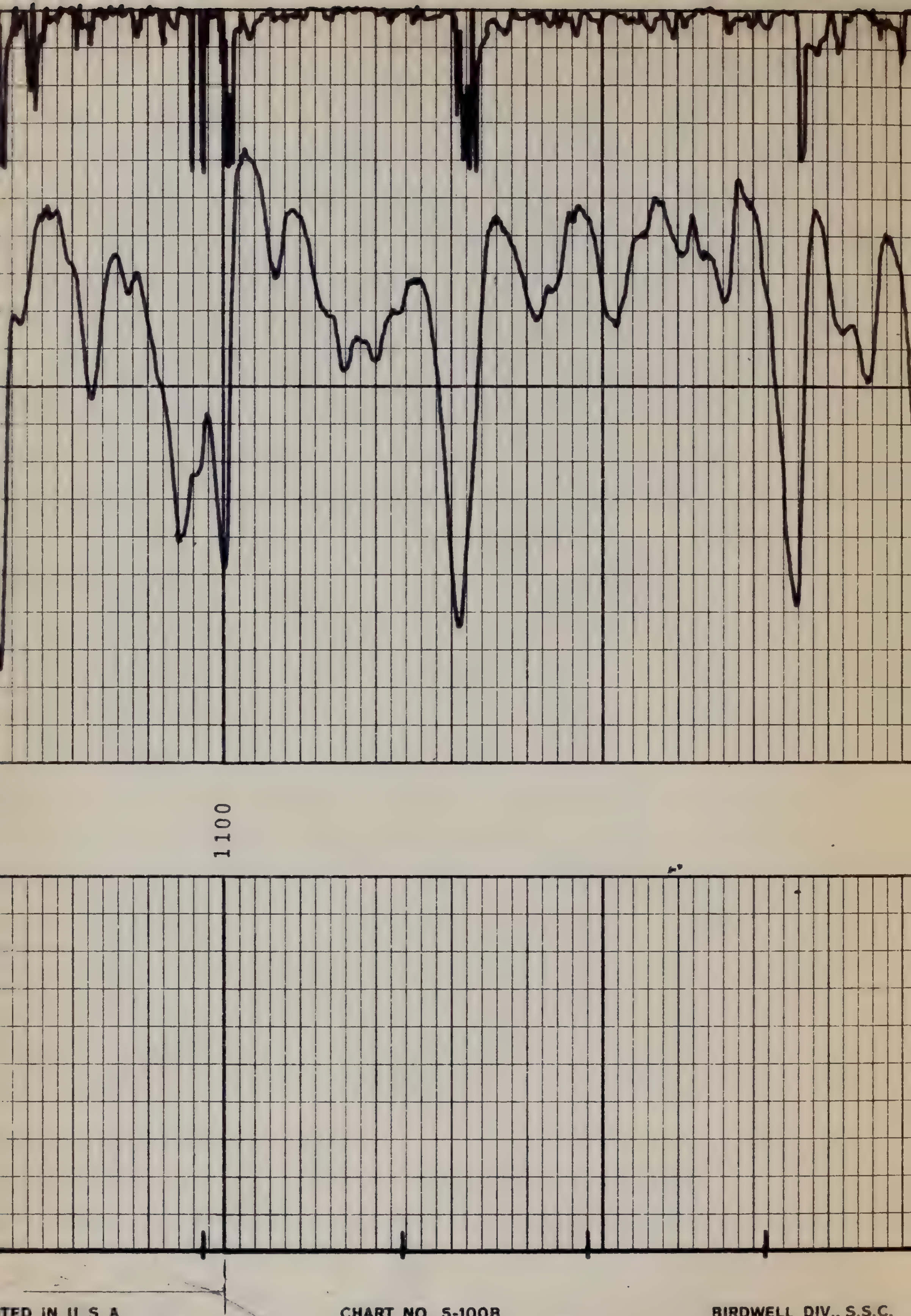
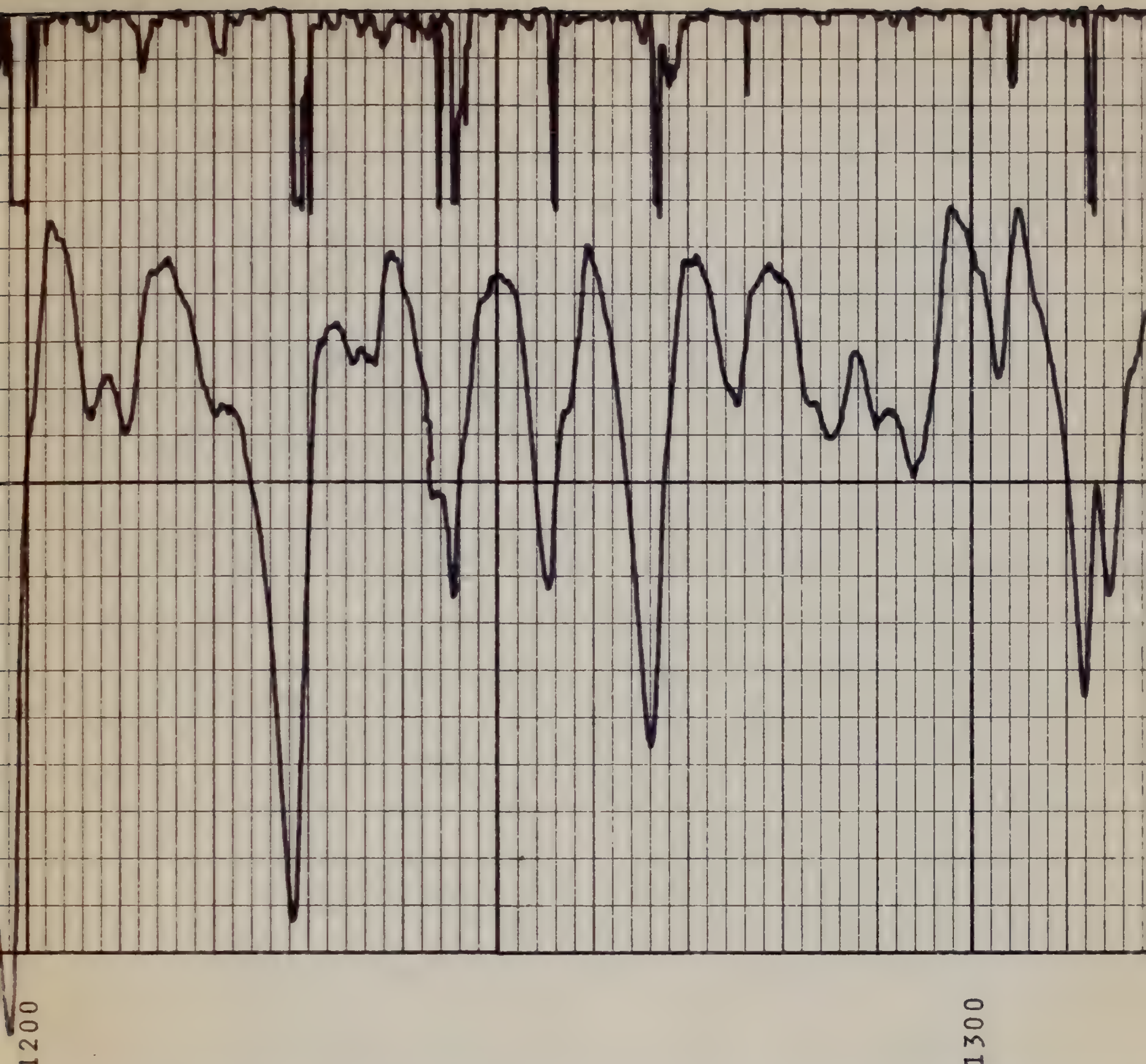
CHART NO. 5-100B
BIRDWELL DIV., S.S.C.
PRI



TED IN U. S. A.   CHART NO. 5-100B   BIRDWELL DIV., S.S.C.



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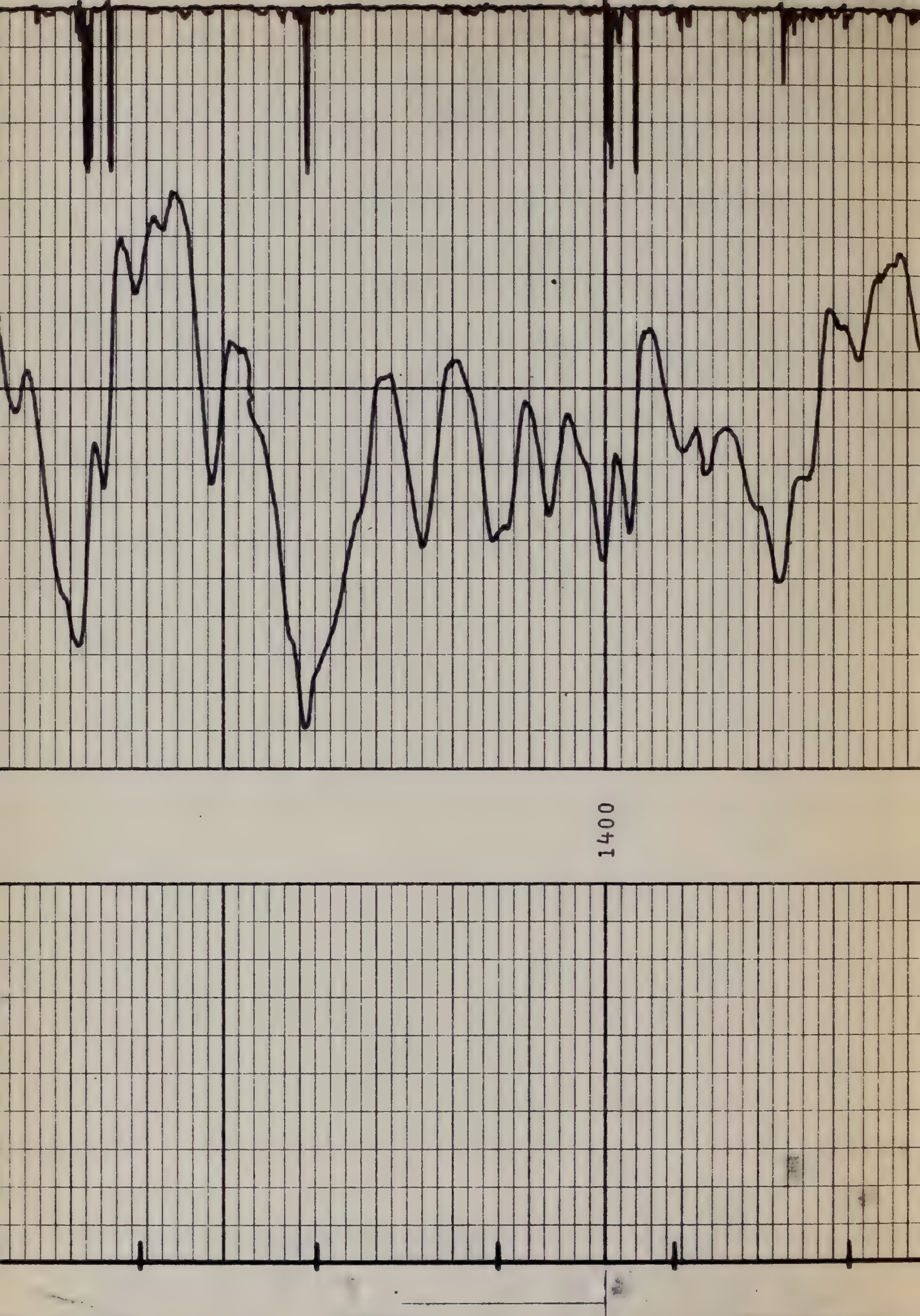

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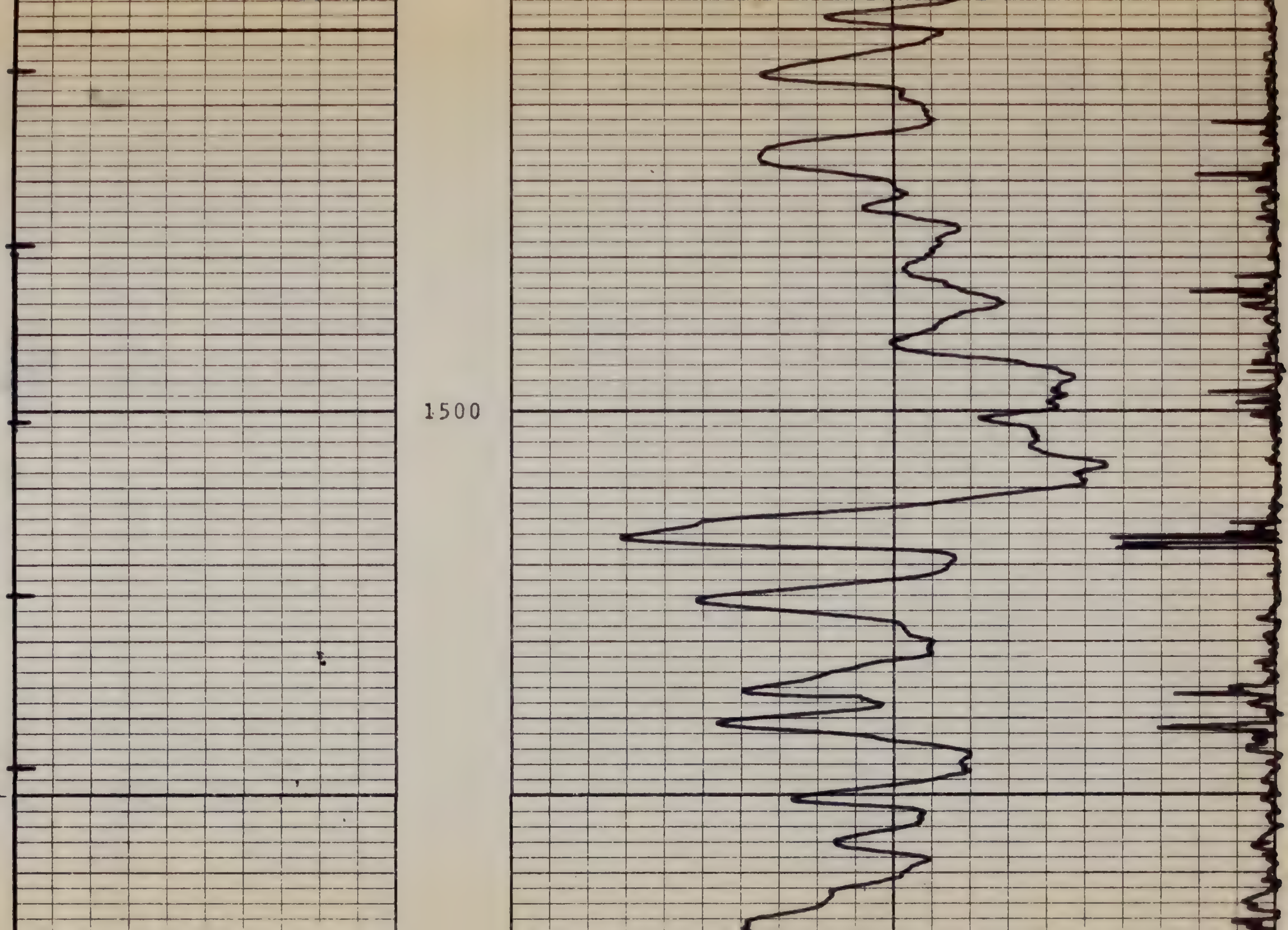
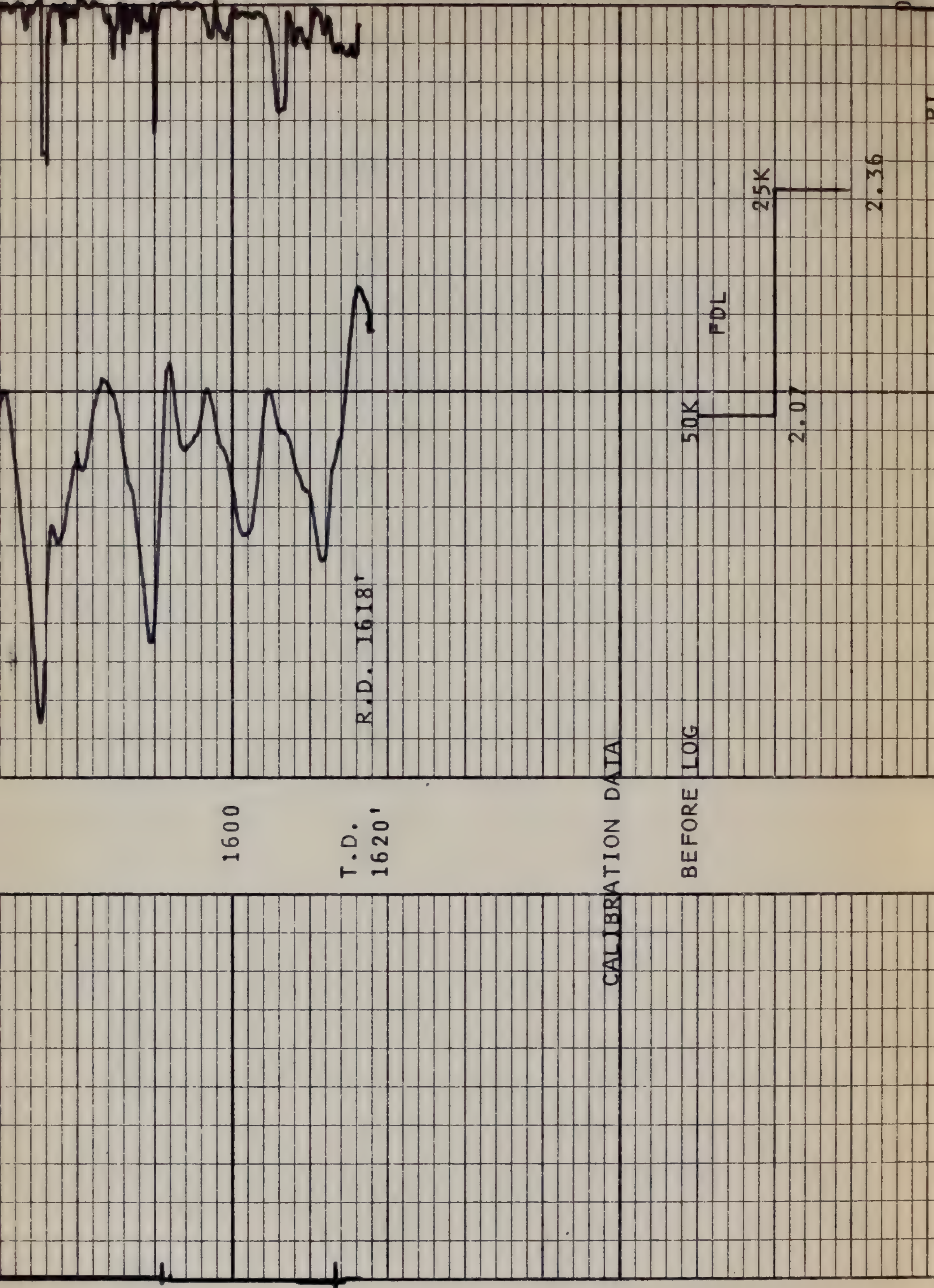


BIRDWELL DIV., S.S.C.

PRINTED IN U. S. A.


R.D. 1618'
1600
T.D.
1620'
CALIBRATION DATA
BEFORE LOG
FDL
50K
25K
2.07
2.36

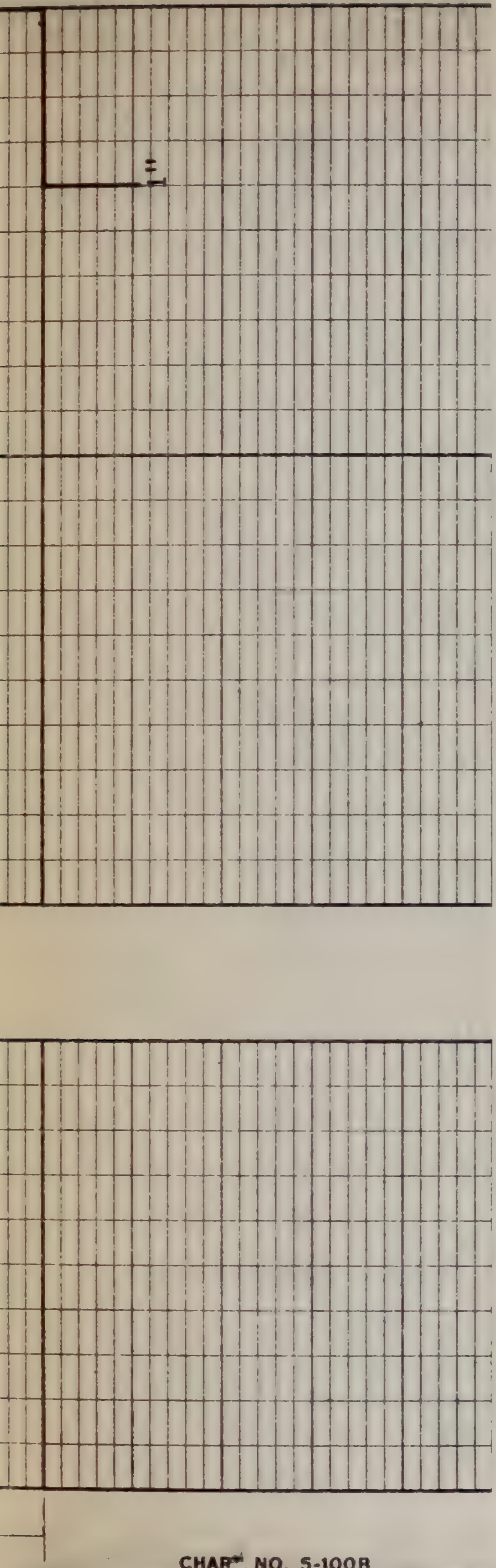


CHART NO. 5-100B

Birdwell

Nuclear Log

COMPANY ATLANTIC RICHFIELD COMPANY,
ET. AL.

WELL SORGHUM GULCH AQUIFER TEST #1-A

FIELD

COUNTY RIO BLANCO **STATE** COLORADO

LOCATION:

SEC. - 7 **TWP.** 3S **RGE.** 96W

OTHER SERVICES
V3D CAL FDL
TL ES

ELEVATIONS:
KB.
DF.
GL. 6909'

PERMANENT DATUM GROUND LEVEL, **ELEV.** 6909'
LOG MEASURED FROM GL, ______ **ft. above perm. datum**
DRILLING MEASURED FROM GL

DATE	2 JULY 74		
RUN NO.	1	1	
TYPE LOG	GR	ENP	
DEPTH – DRILLER	1621	1621	
DEPTH – LOGGER	1620	1620	
BOTTOM LOGGED INTERVAL	1609	1618	
TOP LOGGED INTERVAL	0	10	
TYPE FLUID IN HOLE	WATER	WATER	
SALINITY PPM CL.			
DENSITY LB./GAL.			
LEVEL	412	412	
MAX. REC. TEMP. – DEG. F	78°	78°	
OPERATING RIG TIME	1 HOUR TOTAL TIME		
RECORDED BY	WILSON	WILSON	
WITNESSED BY	TAIT	TAIT	
LOCATION	LAS VEGAS	LAS VEGAS	

RUN NO.	**BORE HOLE RECORD**			**CASING RECORD**			
	BIT	**FROM**	**TO**	**SIZE**	**WGT.**	**FROM**	**TO**
1				7"		0	62'
	6-1/4"	62'	1621'				

THIS HEADING AND LOG CONFORM TO API RP-33 ®

EQUIPMENT DATA

GAMMA RAY

RUN NO.	1		
TOOL MODEL NO.	LAAB		
DIAMETER	3-5/8"		
DETECT. MODEL NO.	MG-70 HIT		
TYPE	GM		
LENGTH	12"		
DIST. TO N. SOURCE	9'		

GENERAL

TRUCK NO.	2694		
TOOL SERIAL NO.			

NEUTRON

RUN NO.	1		
LOG TYPE	ENP		
TOOL MODEL NO.	LABB		
DIAMETER	3-5/8"		
DETECT. MODEL NO.	9373 TN		
TYPE	GM		
LENGTH	6"		
SOURCE MODEL NO.	MRC		
SERIAL NO.	289		
SPACING	15.5"		
TYPE	PU:8BE		
STRENGTH-N/SEC.	$.72X10^7$		

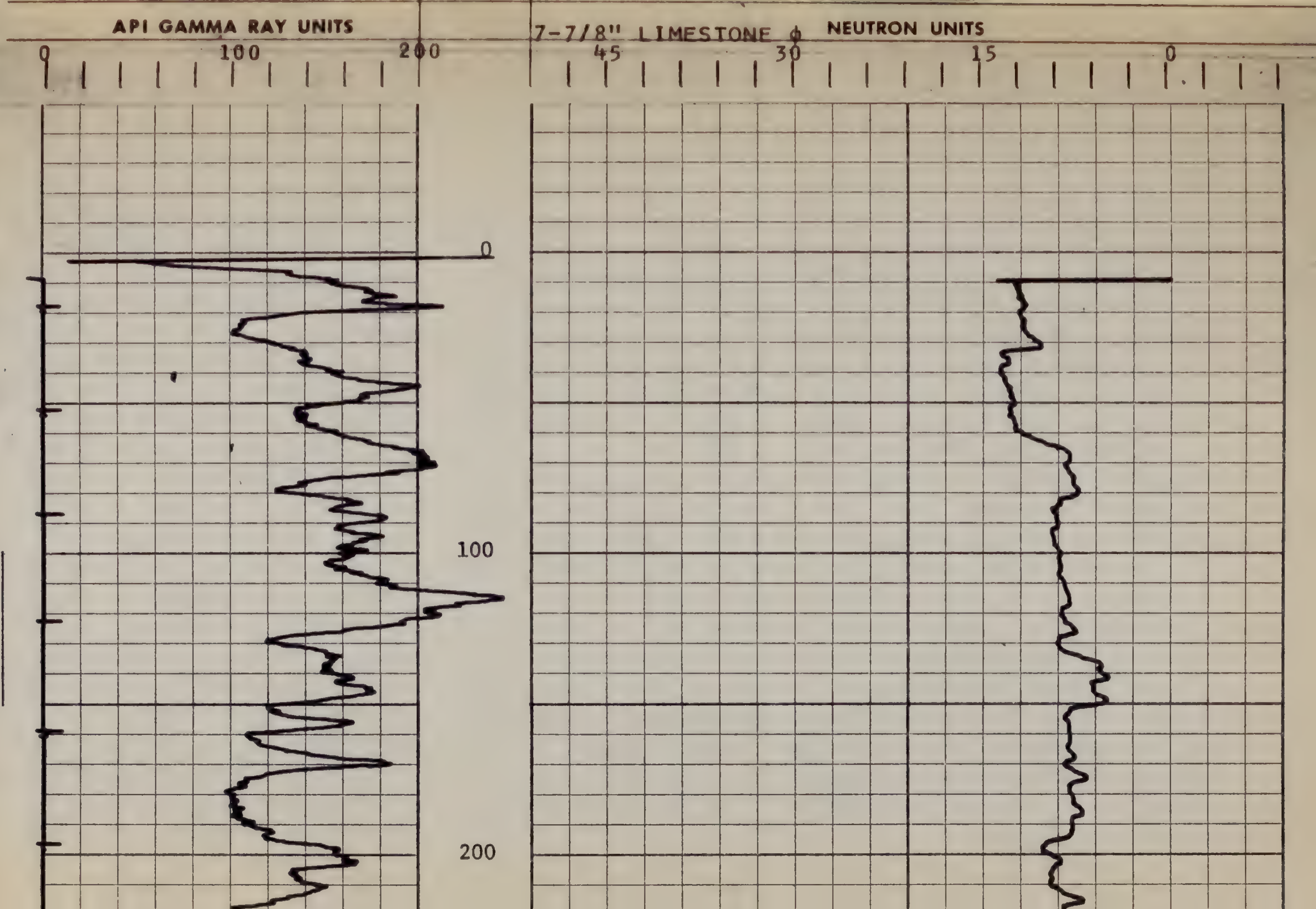
LOGGING DATA

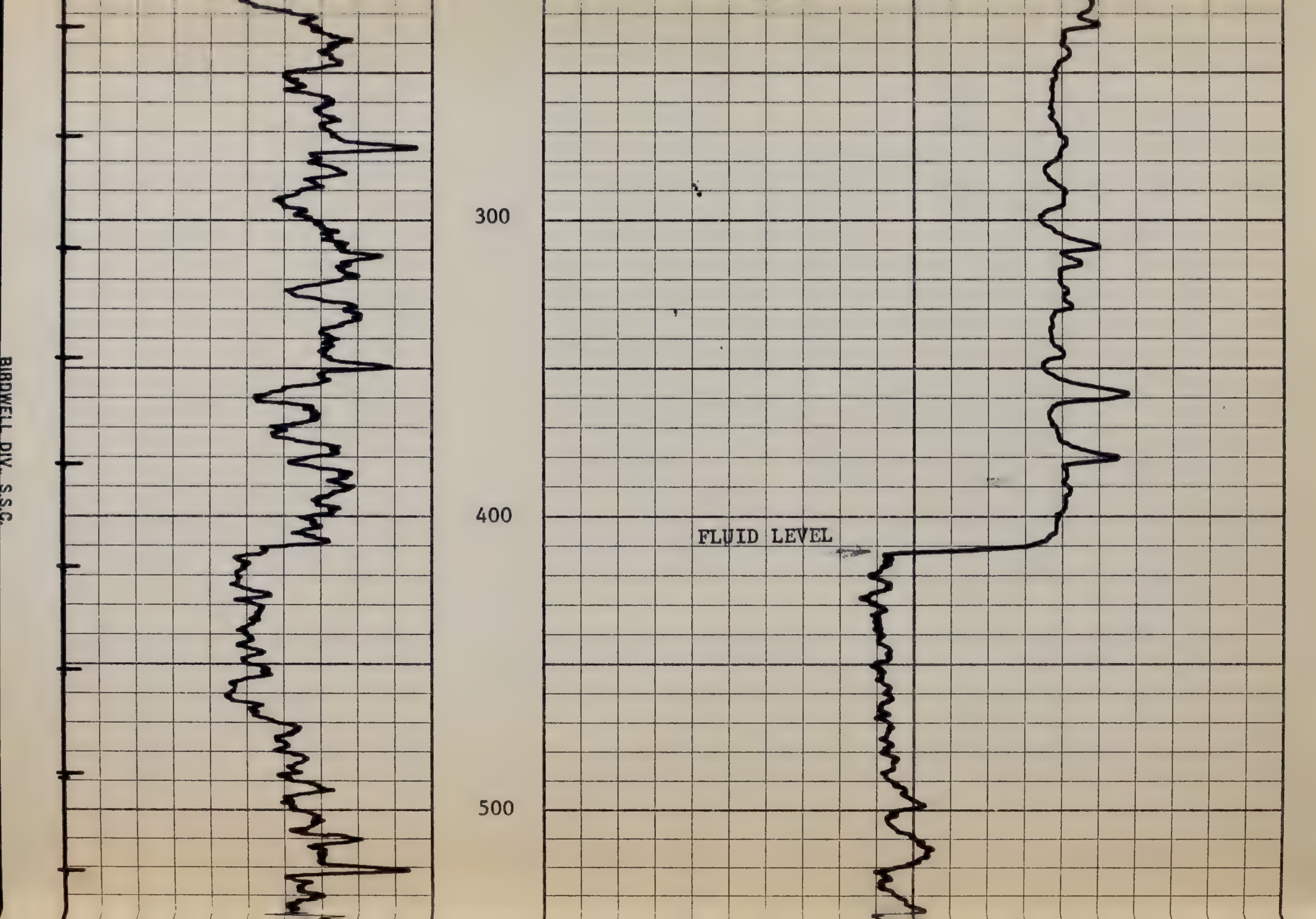
GENERAL				GAMMA RAY				NEUTRON			
RUN NO.	DEPTHS FROM	DEPTHS TO	SPEED FT/MIN	T.C. SEC.	CPM FULL SCALE	ZERO DIV. L OR R	API G.R. UNITS PER LOG DIV.	T.C. SEC.	CPM FULL SCALE	ZERO DIV. L OR R	N. UNITS PER LOG DIV.
1	1609	0	20	3	$20X10^3$	0	20				
	1618	10	20					3	$50X10^3$		3%/DIV.

REFERENCE LITERATURE:

REMARKS: THIS WORK WAS PERFORMED UNDER UNITED STATES ATOMIC ENERGY COMMISSION BY-PRODUCT MATERIAL LICENSE NO. 35-05651-01 AND SPECIAL NUCLEAR MATERIALS LICENSE NO. SNM-161

GAMMA RAY	DEPTH	NEUTRON


API GAMMA RAY UNITS
0
100
200
7-7/8" LIMESTONE ϕ NEUTRON UNITS
45
30
15
0
0
100
200


BIRDWELL DIV., S.S.C.
300
400
500
FLUID LEVEL

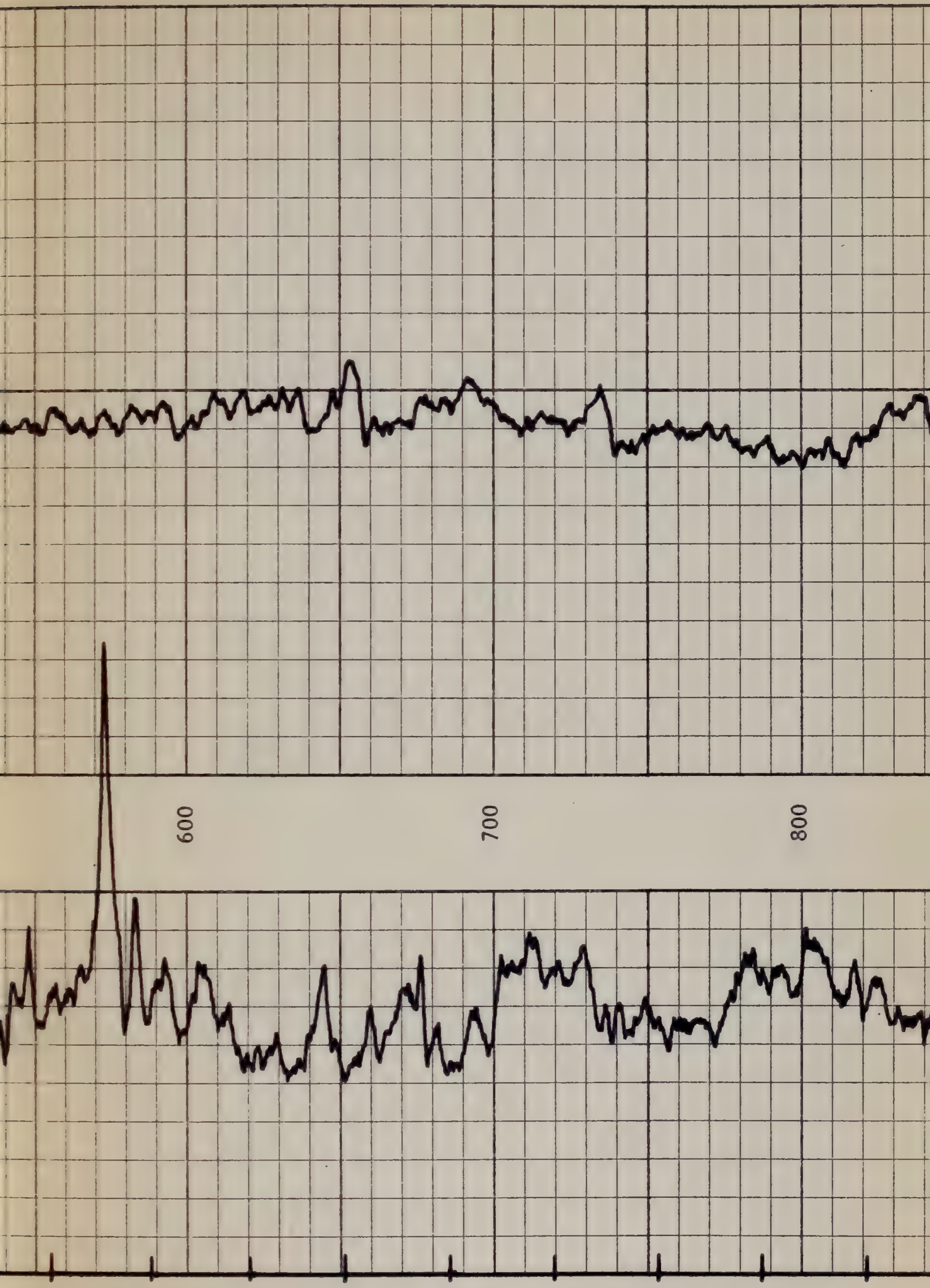
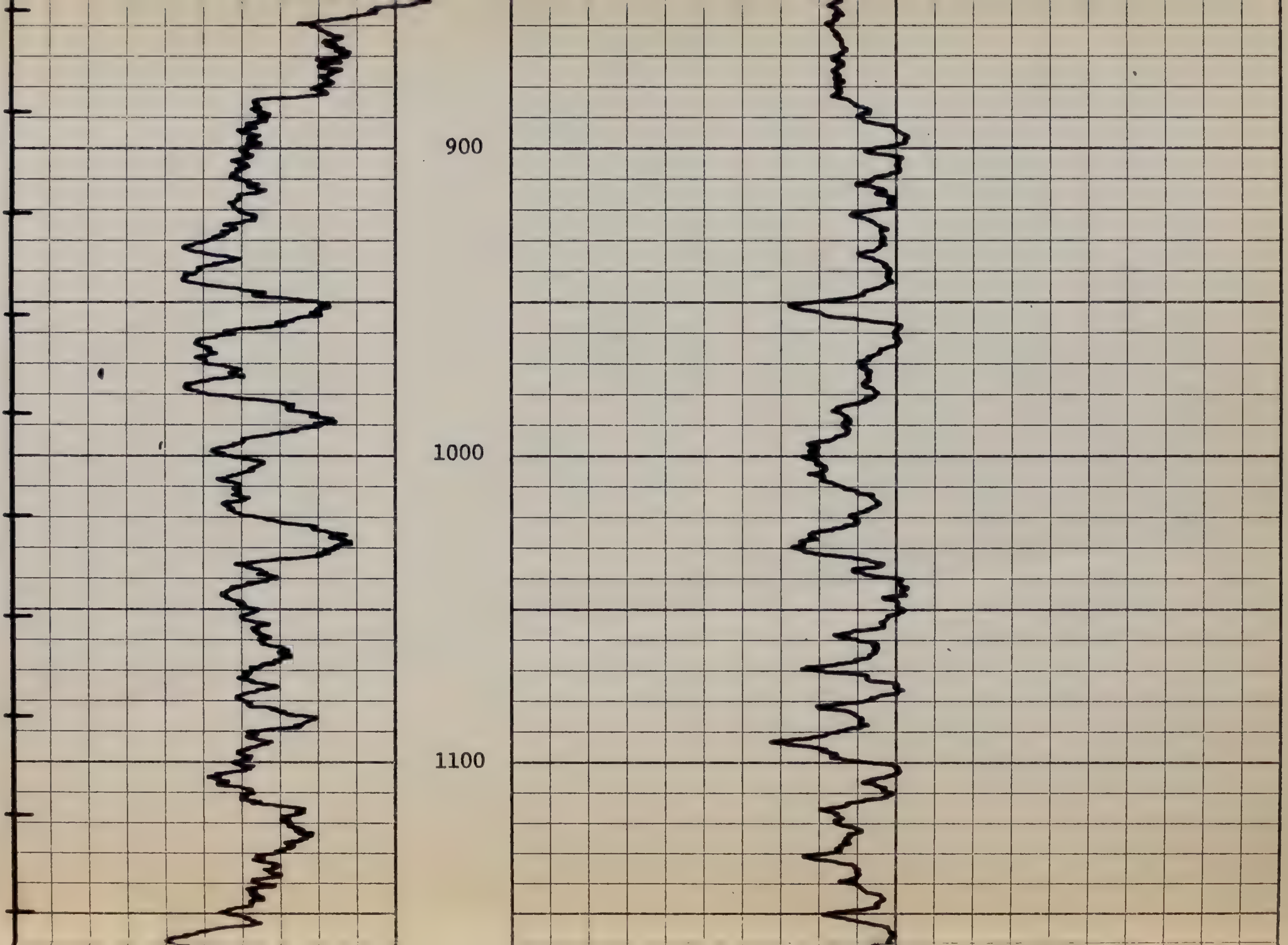
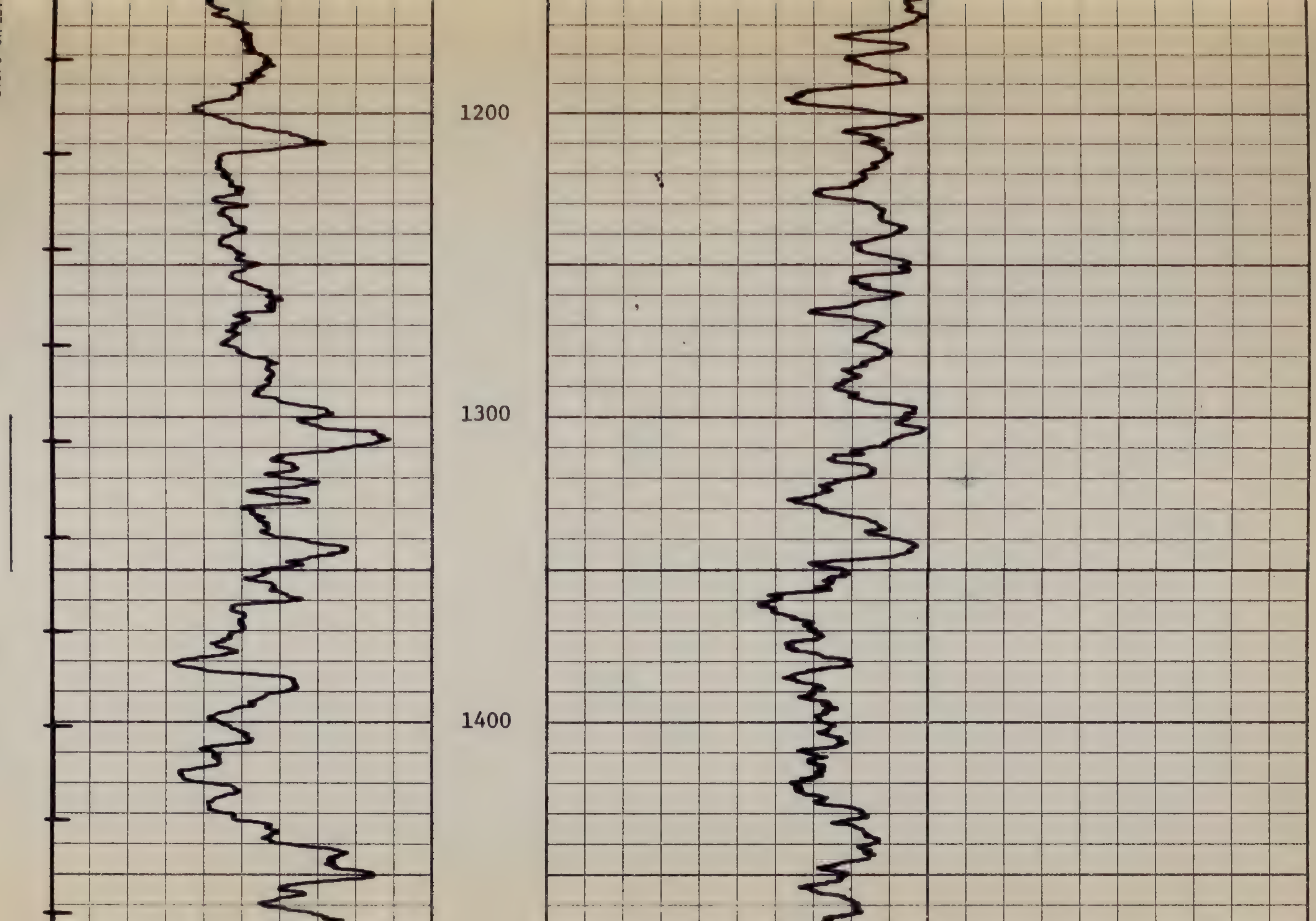


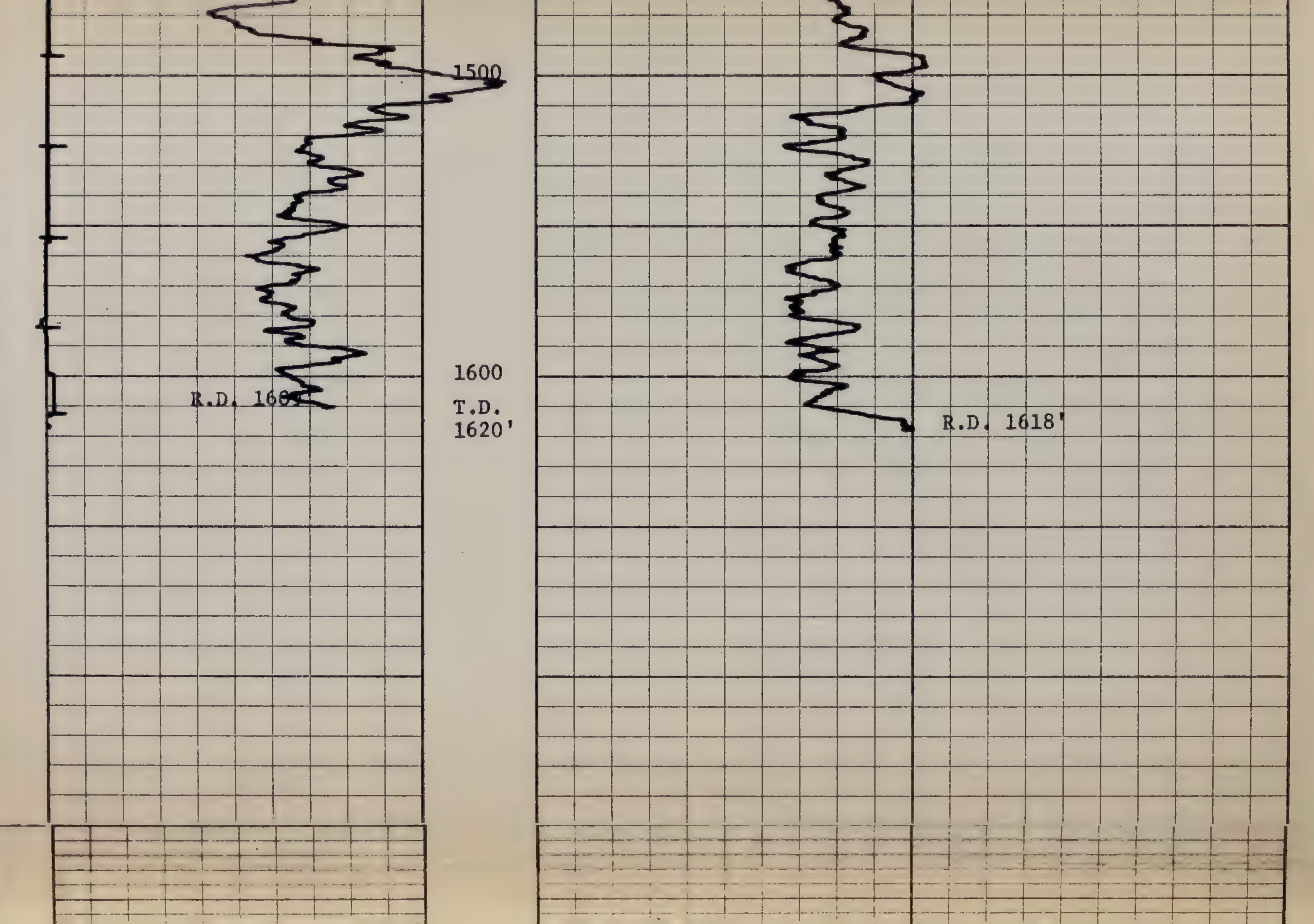
CHART NO. 2-1008



BIRDWELL DIV., S.S.C.



ART NO. 2-100B



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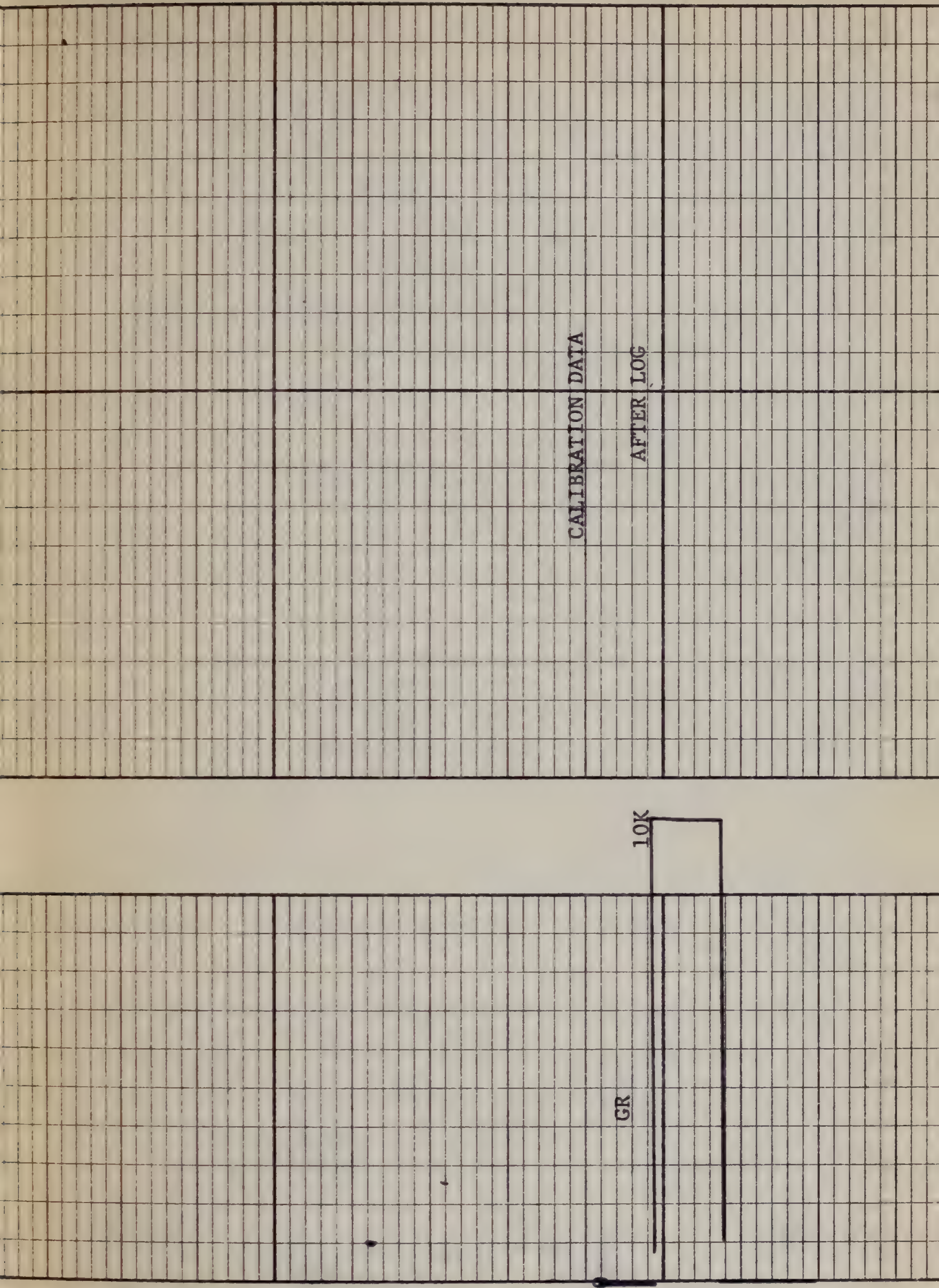
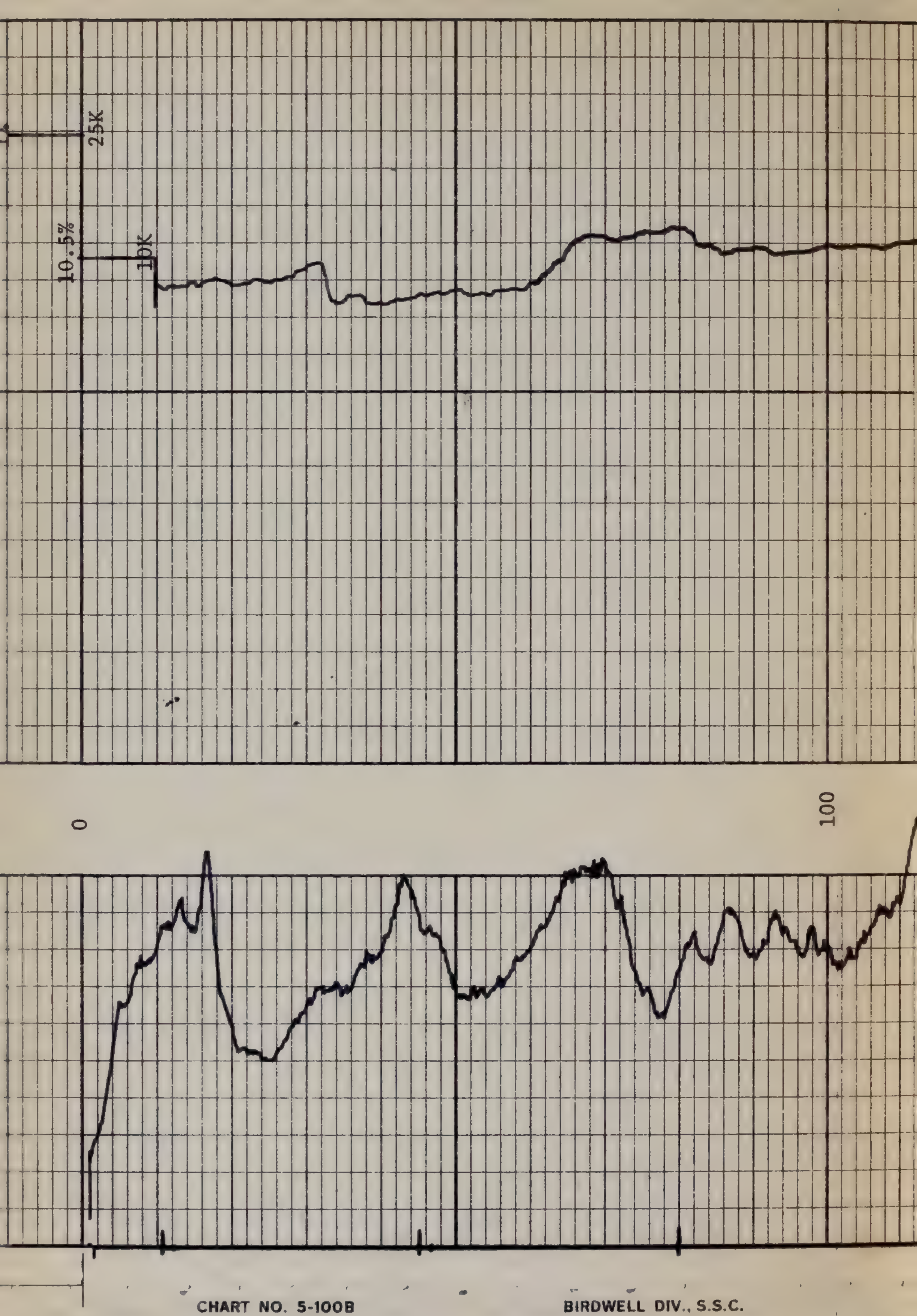
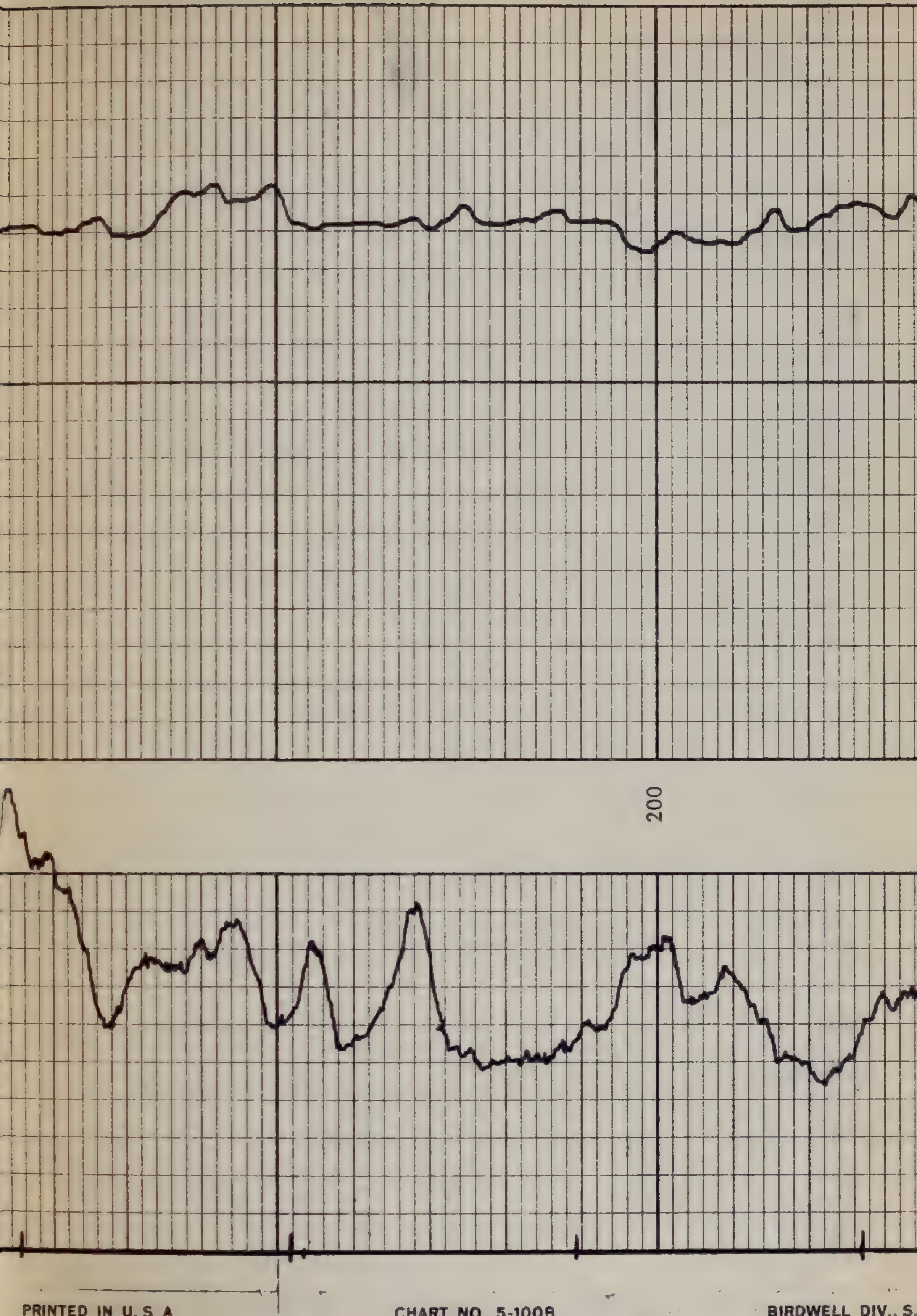
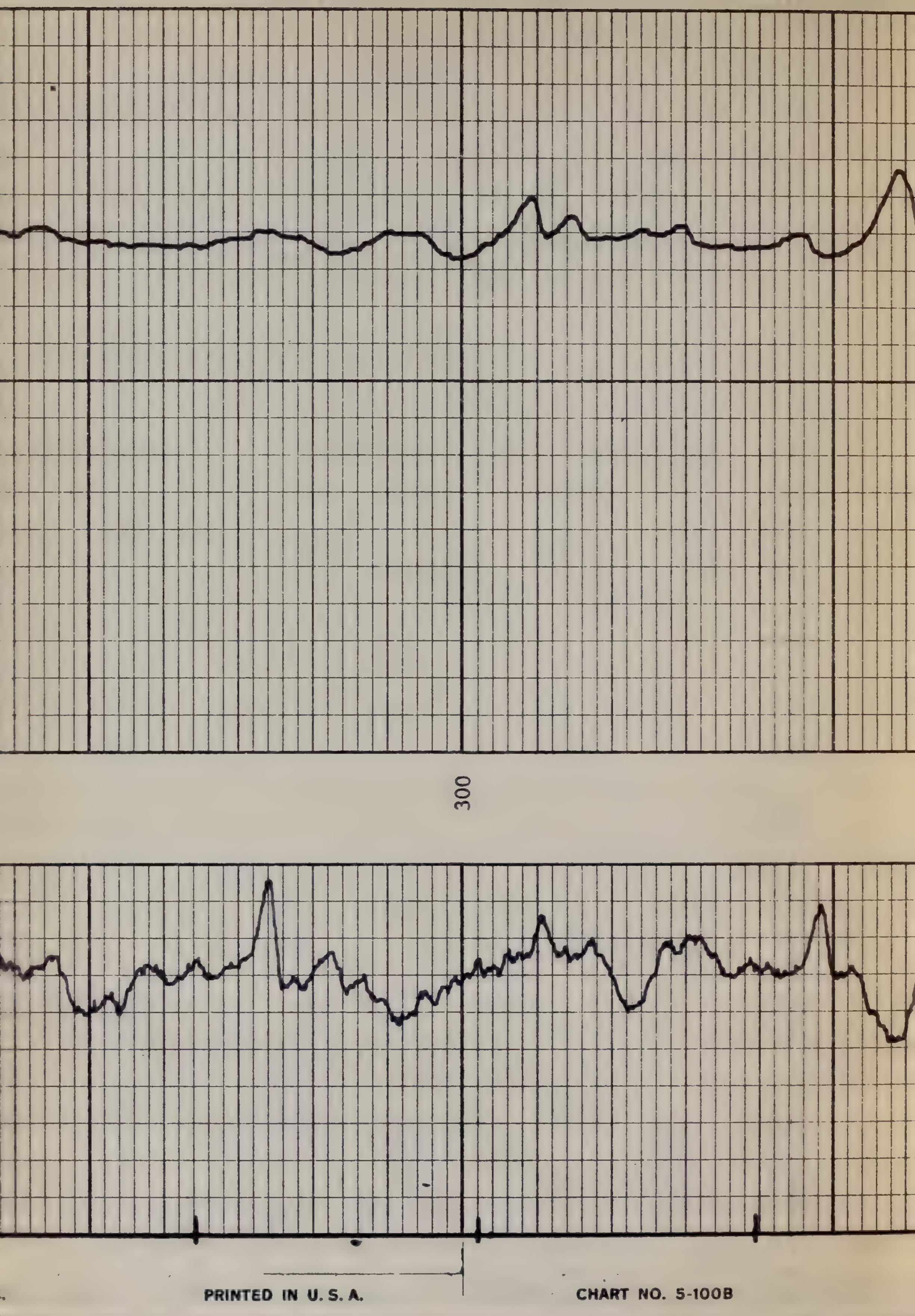


CHART NO. 5-100B BIRDWELL DIV., S.S.C. PRINTED IN U. S. A


25K
10.5%
10K
0
100
CHART NO. 5-100B
BIRDWELL DIV., S.S.C.


200
PRINTED IN U. S. A.
CHART NO. 5-100B
BIRDWELL DIV., S.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PRINTED IN U. S. A.
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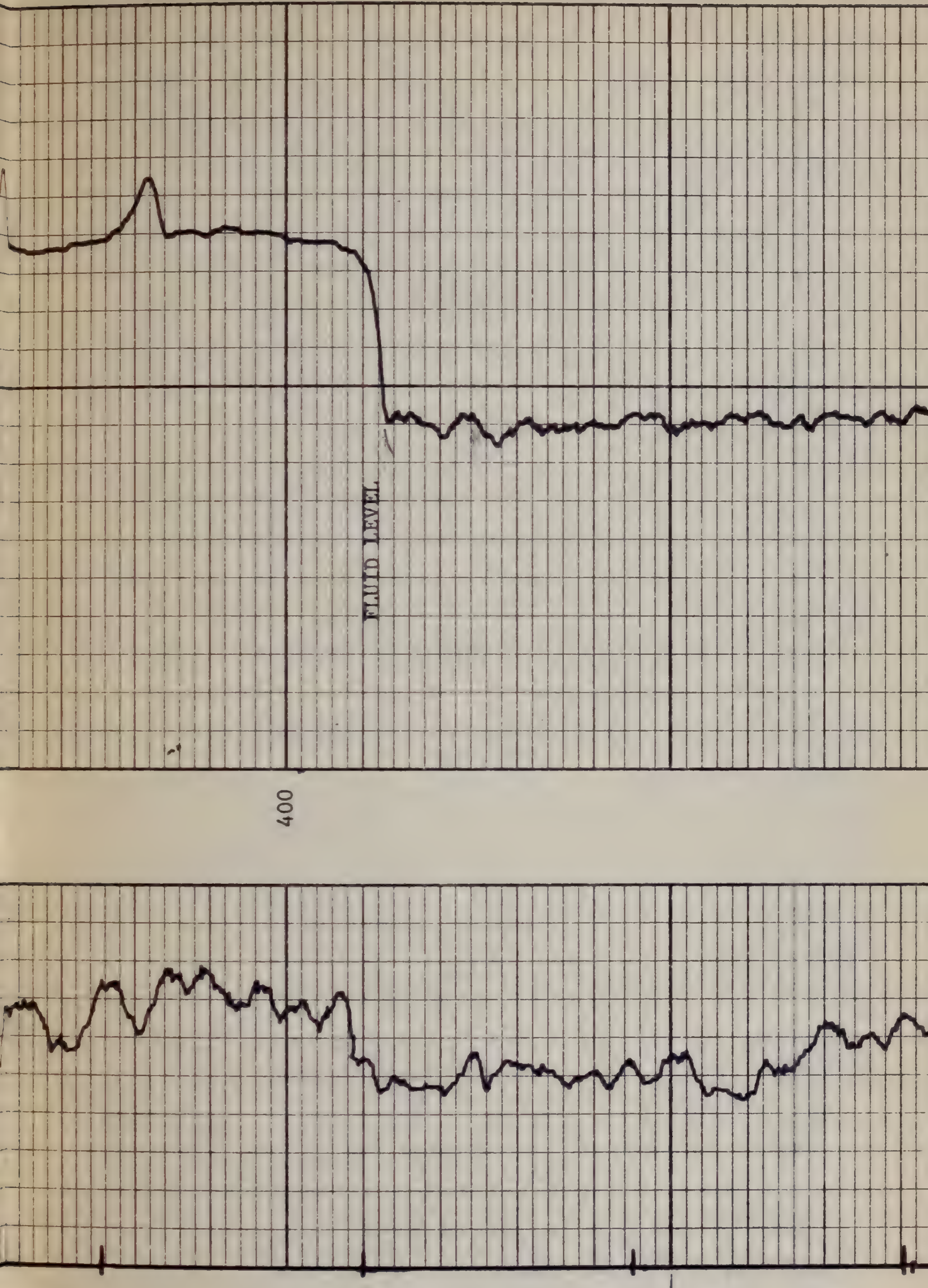
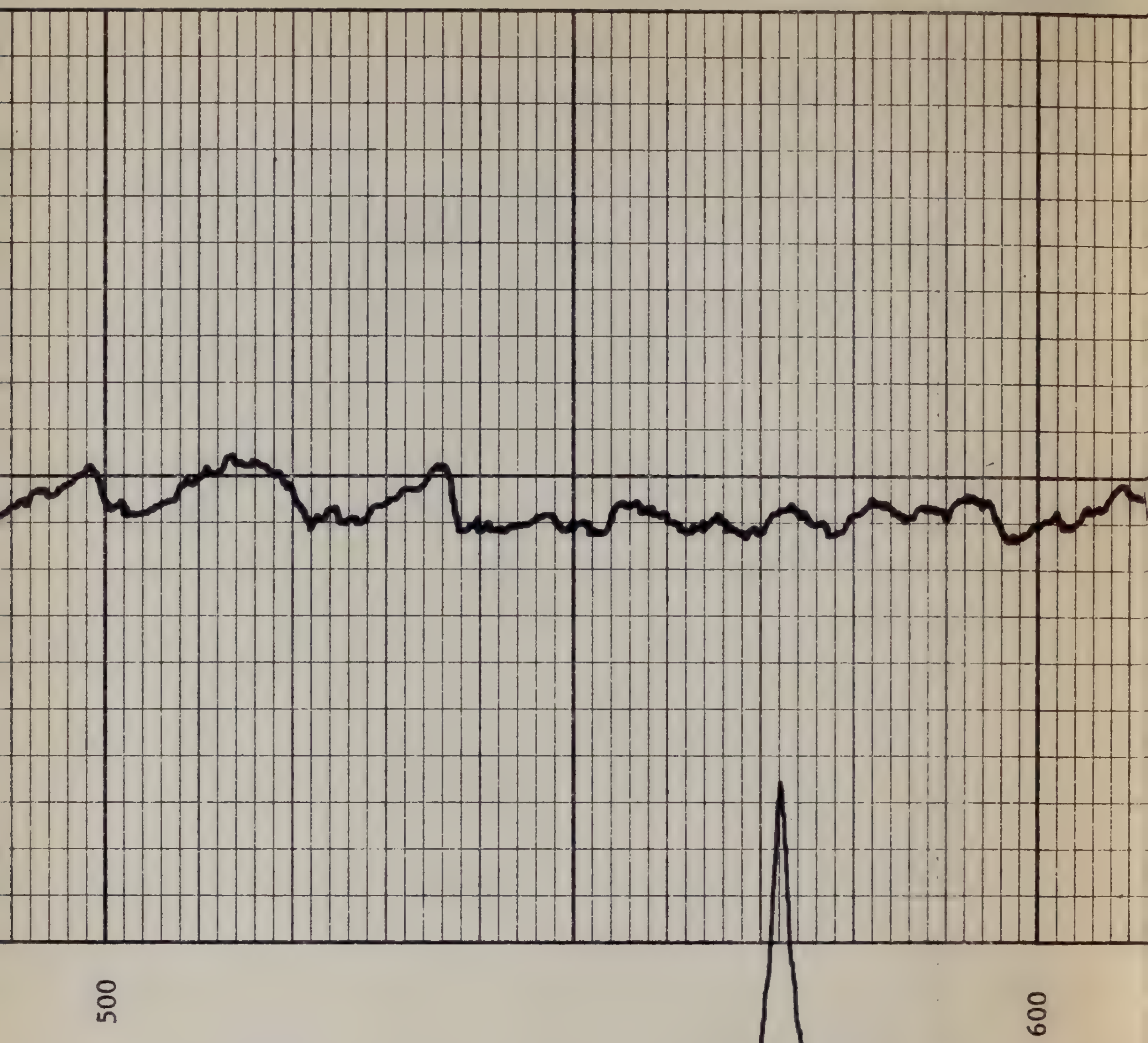
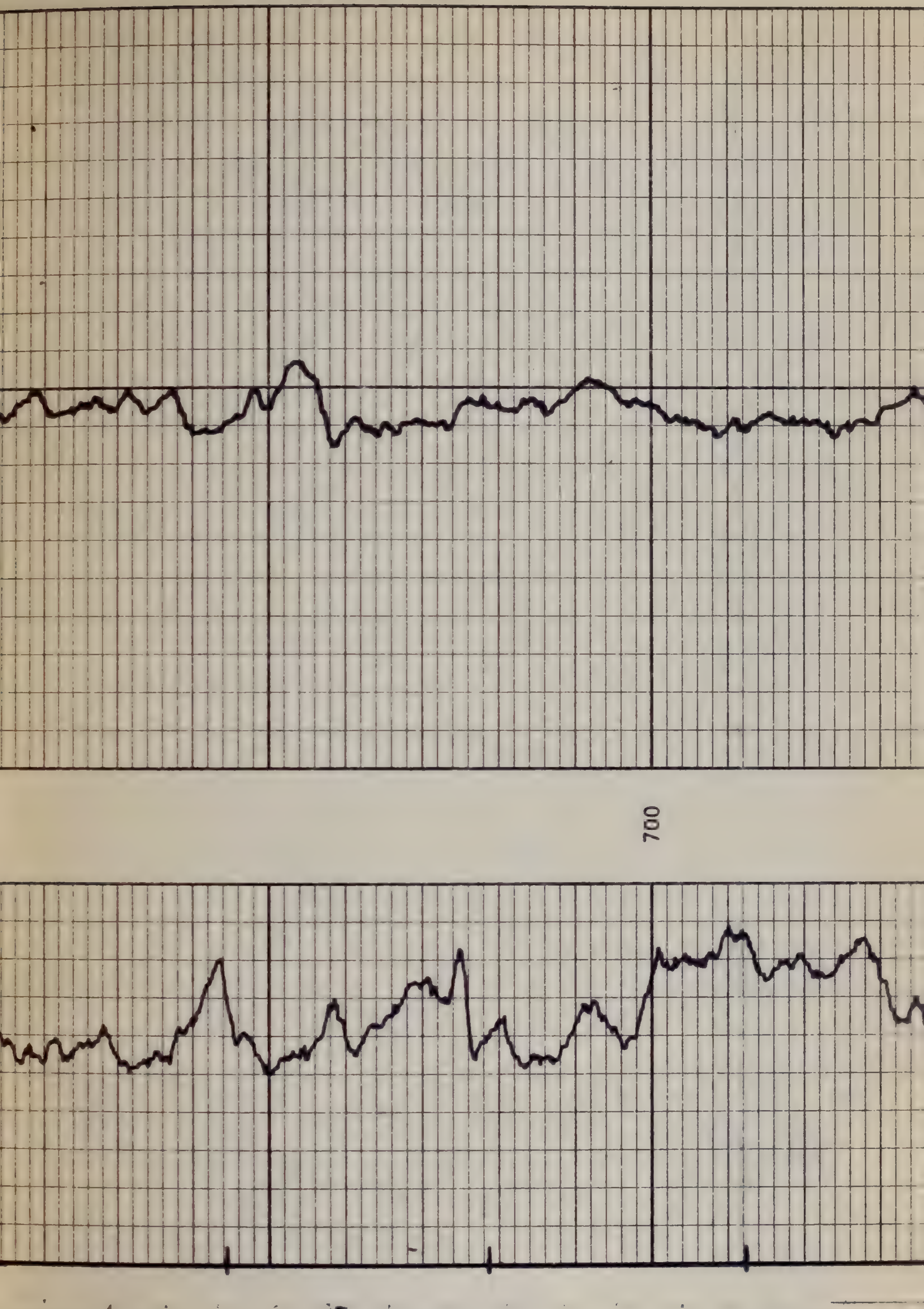


BIRDWELL DIV., S.S.C. PRINTED IN U. S. A. CHART NO. 5-10



BIRDWELL DIV., S.S.C.
PRINTED IN U. S. A.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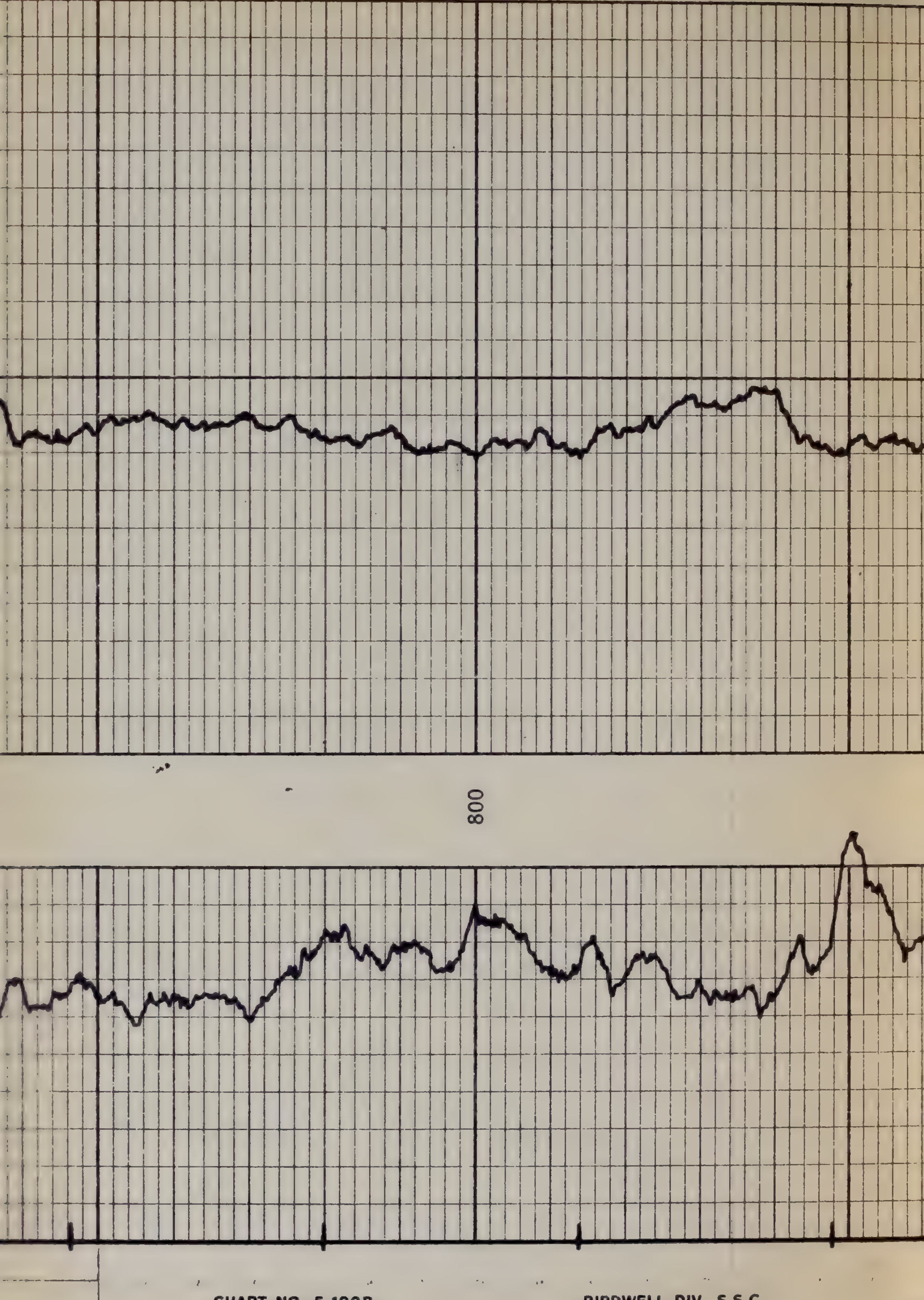
PRINTED IN U. S. A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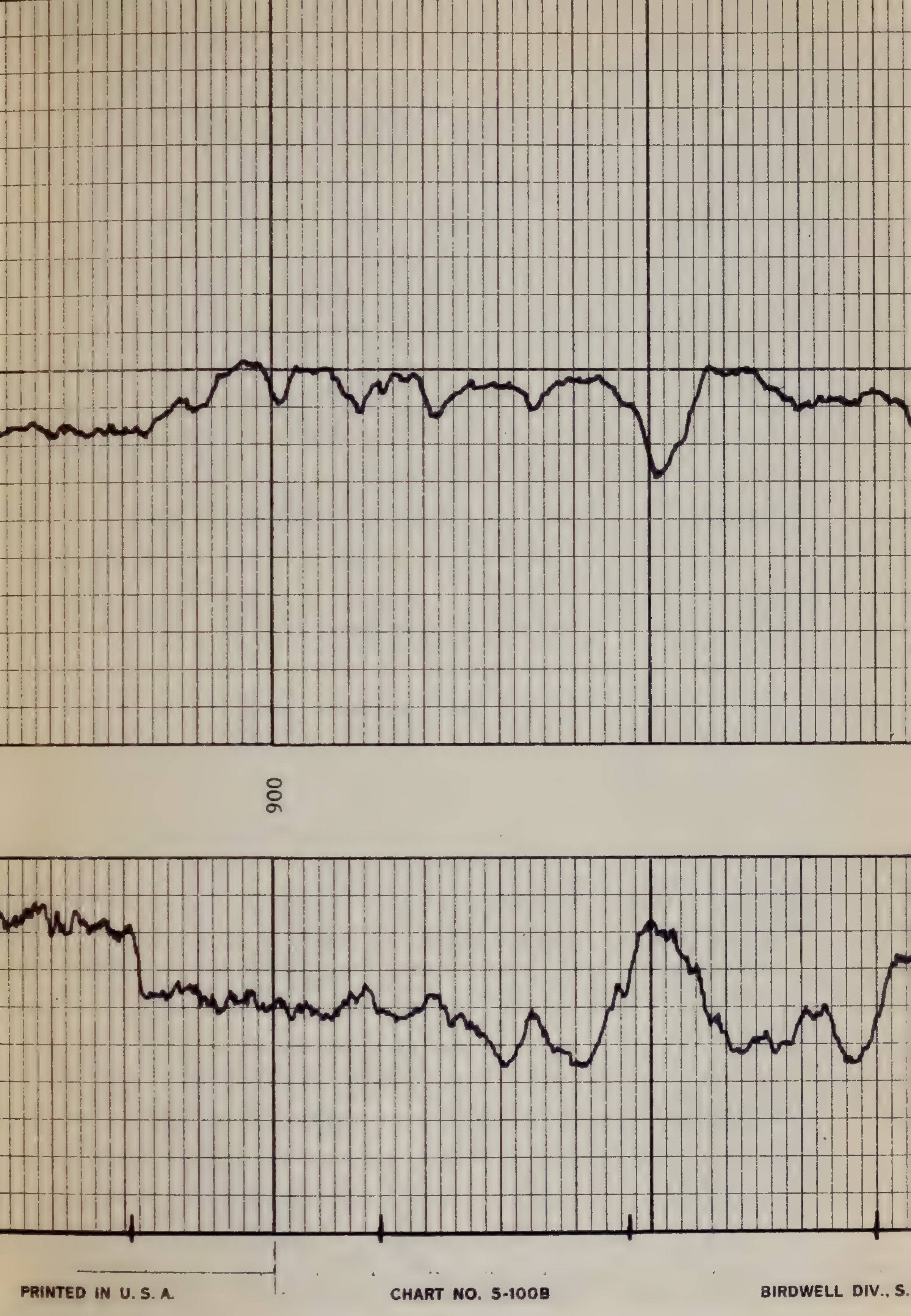
BIRDWELL DIV., S.S.C.


900
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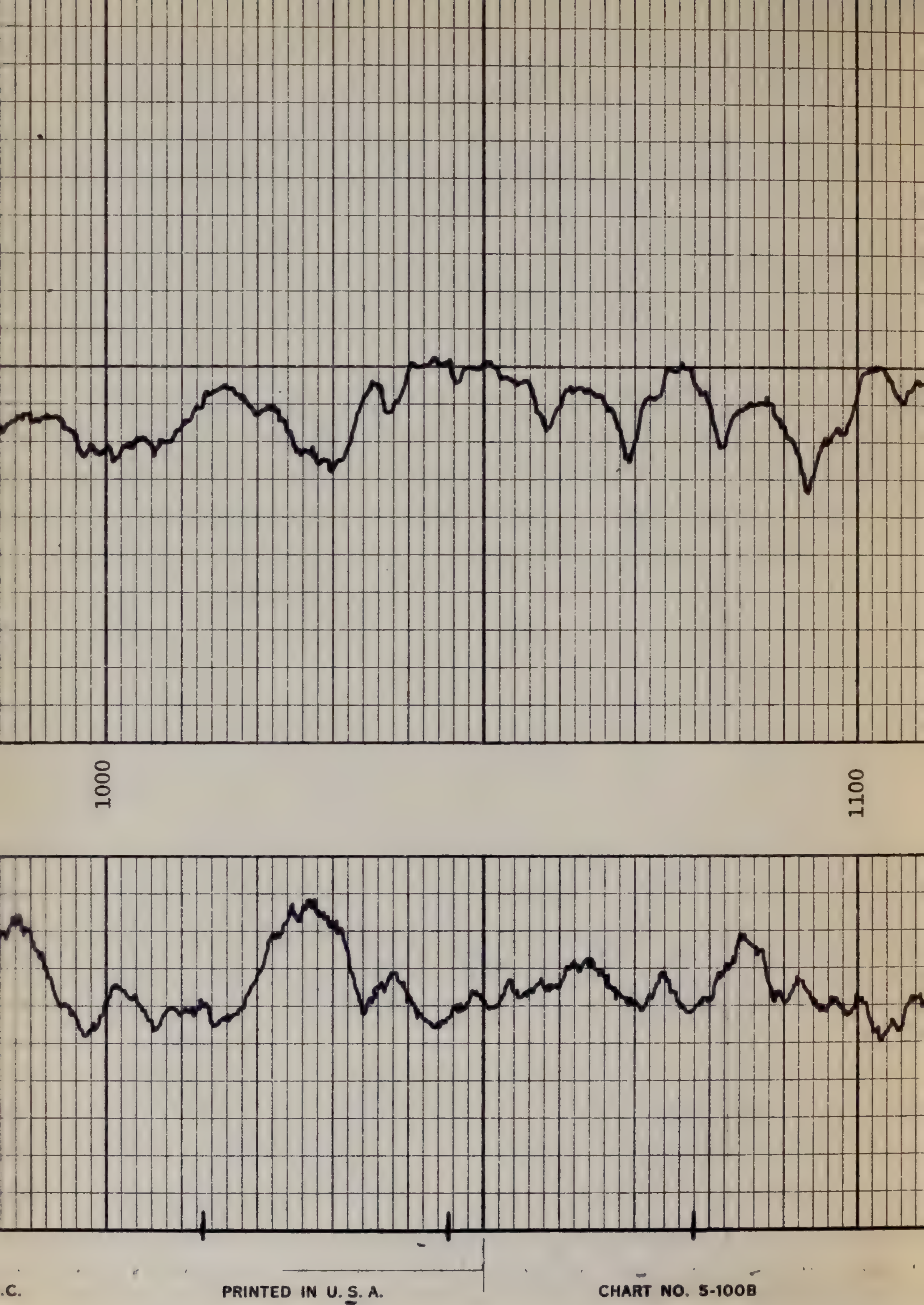
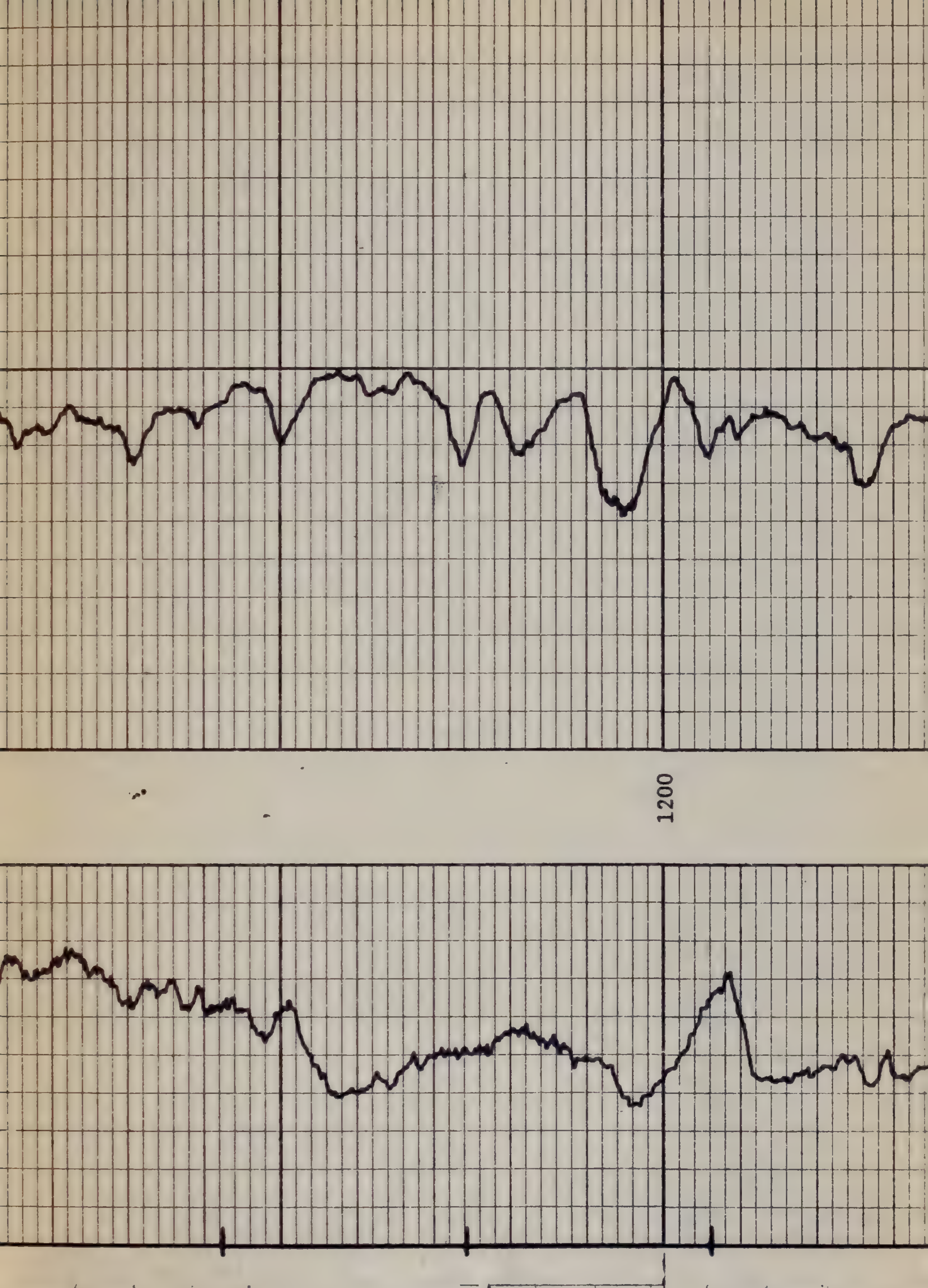
BIRDWELL DIV., S.


1000
1100
.C.
PRINTED IN U.S.A.
CHART NO. 5-100B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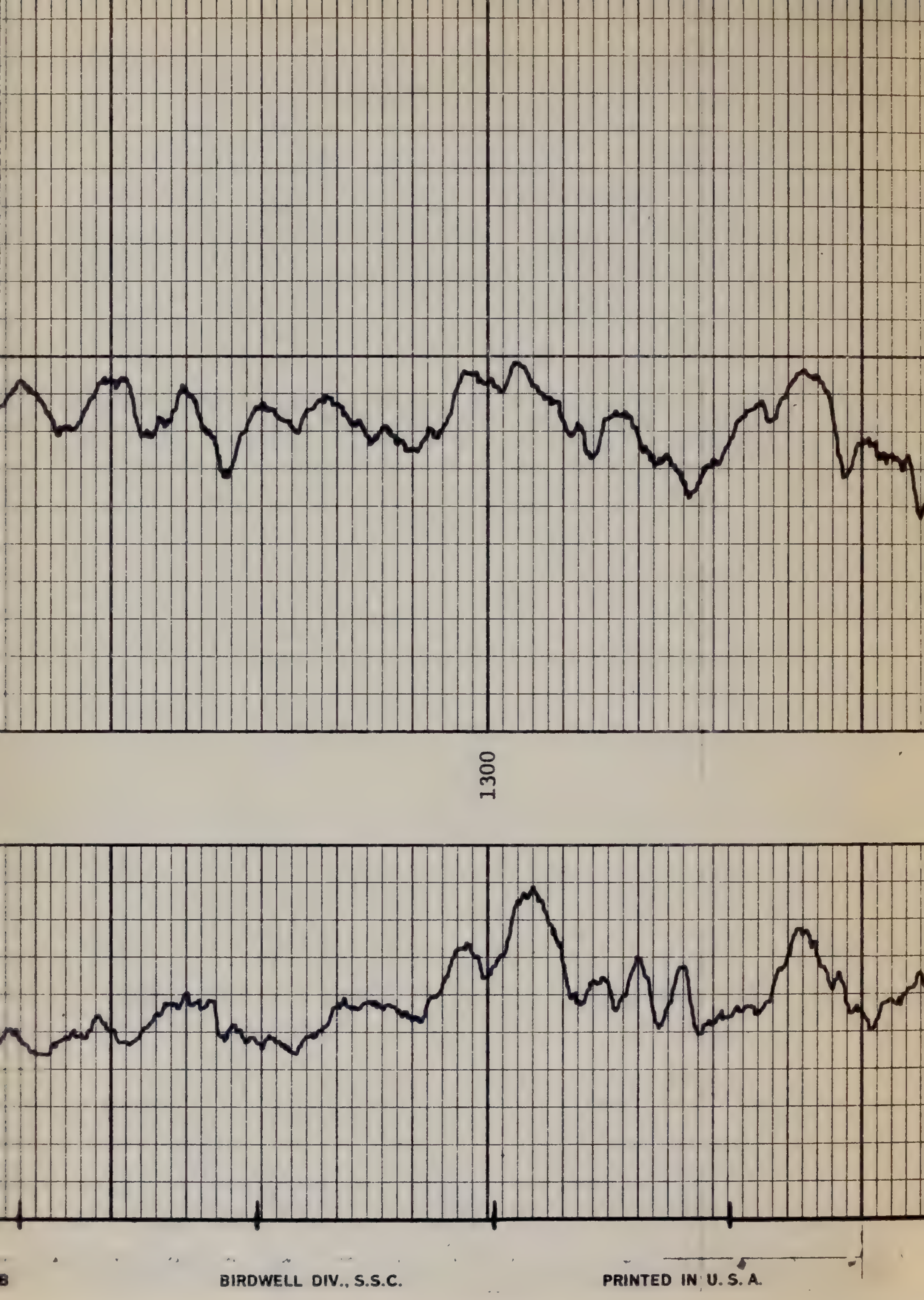
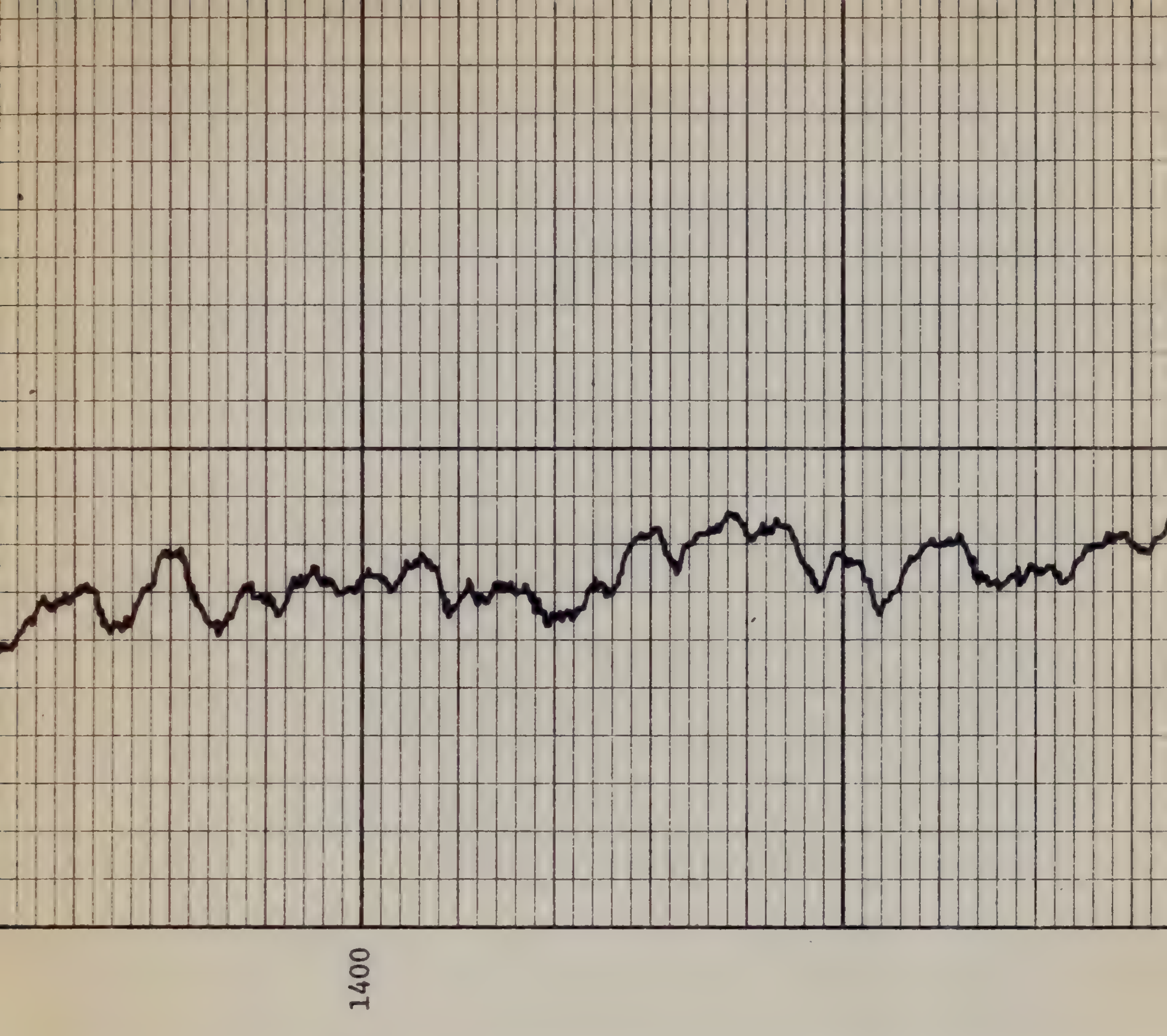


1300
B
BIRDWELL DIV., S.S.C.
PRINTED IN U. S. A.



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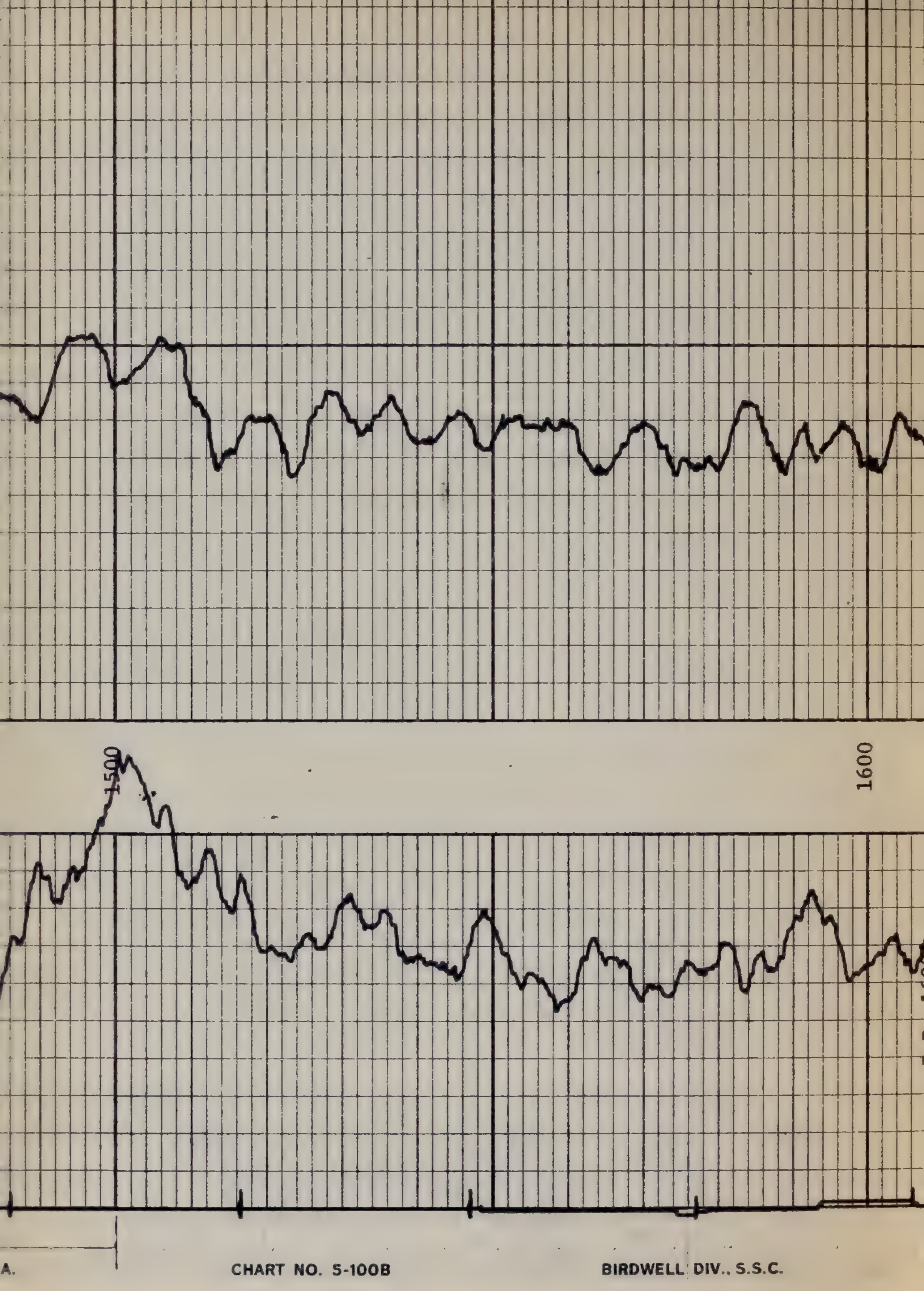
1500
1600
A.
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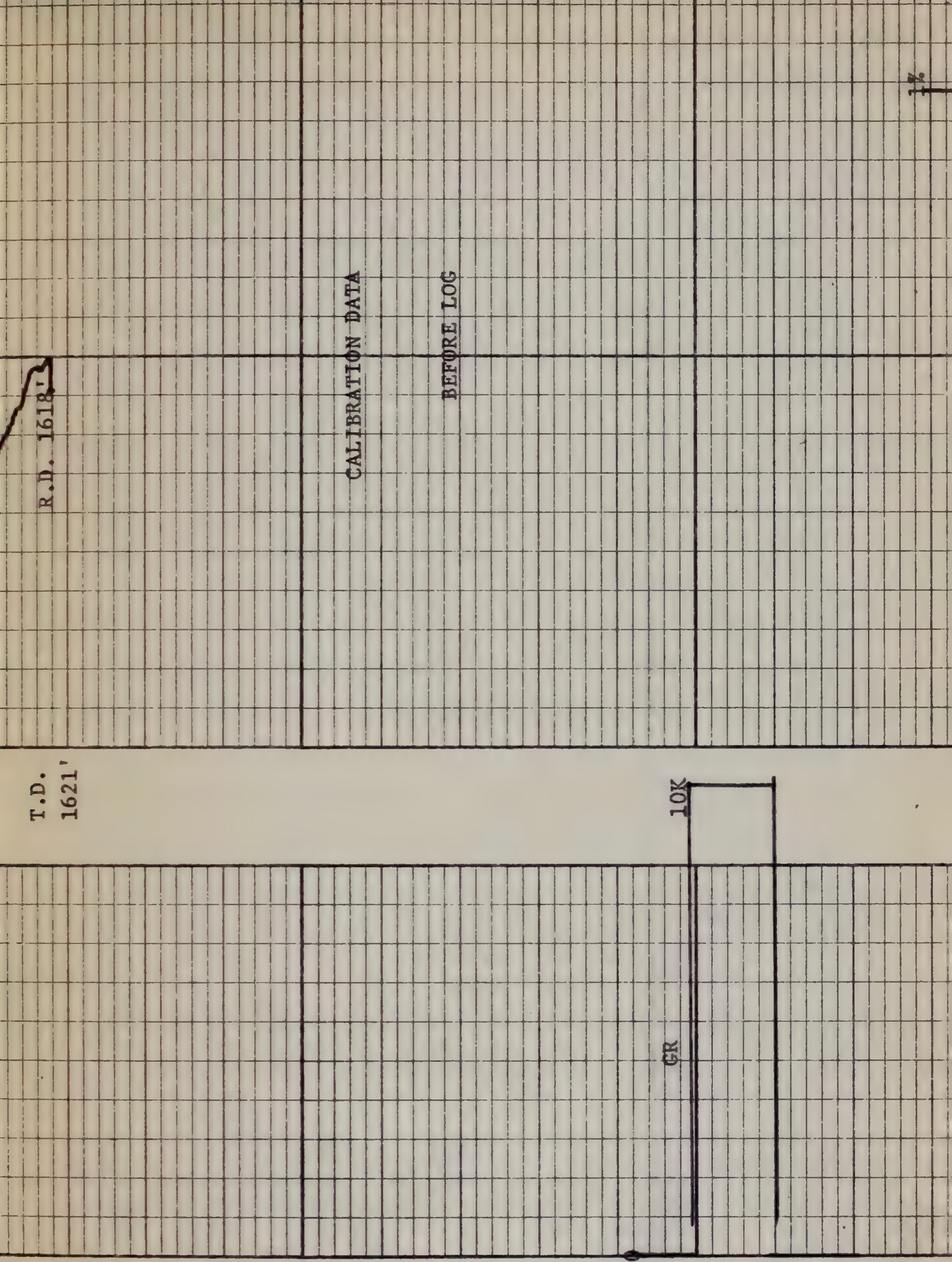
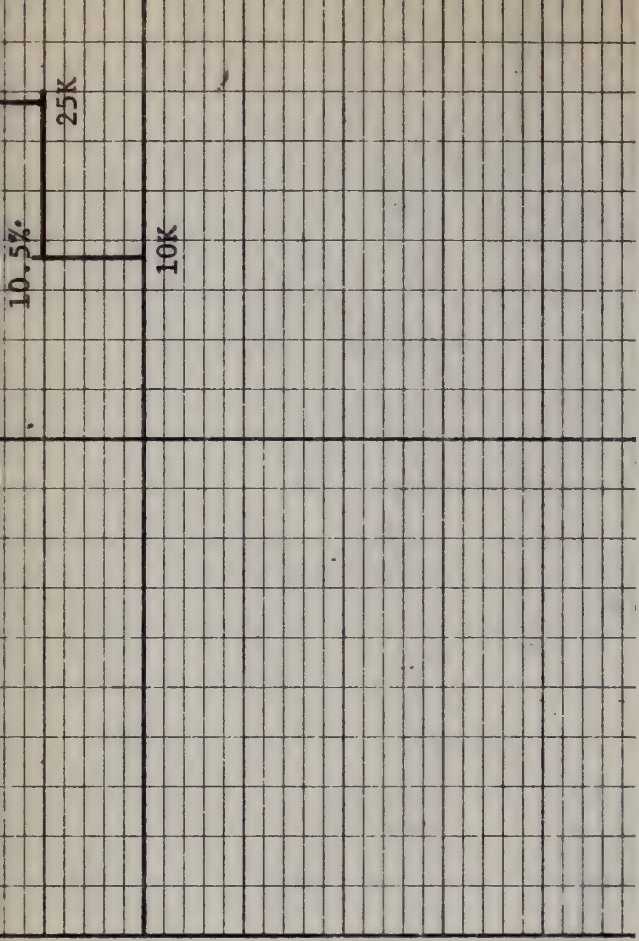
BIRDWELL DIV., S.S.C.



PRINTED IN U.S.A.   CHART NO. 5-100B   BIRDWELL DIV..



.C. PRINTED IN U. S. A.

Birdwell

Caliper Log

FILING NO.

COMPANY ATLANTIC RICHFIELD COMPANY, ET. AL.

WELL SORGHUM GULCH AQUIFER TEST #1-A

FIELD

COUNTY RIO BLANCO **STATE** COLORADO

LOCATION:

SEC. 7 TWP. 3S RGE. 96W

OTHER SERVICES:

GR/ENP TL
V3D FDL ES

ELEVATIONS:

KB.
DF.
GL. 6909'

PERMANENT DATUM GROUND LEVEL ELEV. 6909'
LOG MEASURED FROM GL
DRILLING MEASURED FROM GL

DATE	2 JULY 74		
RUN NO.	1		
TYPE LOG	CAL		
DEPTH—DRILLER	1621		
DEPTH—LOGGER	1620		
BOTTOM LOGGED INTERVAL	1618		
TOP LOGGED INTERVAL	10		
TYPE FLUID IN HOLE	WATER		
SALINITY PPM CL.			
DENSITY LB./GAL.			
LEVEL	412		
MAX. REC. TEMP.—DEG. F.	78°		
OPR. RIG TIME	1/2 HR.		
RECORDED BY	WILSON		
WITNESSED BY	TAIT		
LOCATION	LAS VEGAS		

RUN NO.	BORE HOLE RECORD			CASING RECORD			
	BIT	FROM	TO	SIZE	WGT.	FROM	TO
1				7"		0	62'
	6-1/4"	62'	1621'				

SSC-607-D

EQUIPMENT DATA			
TYPE LOG	CALIPER		
TOOL MODEL	LEBB		
TOOL SERIAL NO.			
TOOL DIAMETER	3-5/8"		
SPEED FT./MIN.	40		
SCALE	1/2"/DIV.		
MIN. ARM DIAM.	3-5/8"		
MAX. ARM DIAM.	34"		
TRUCK NO.	2694		

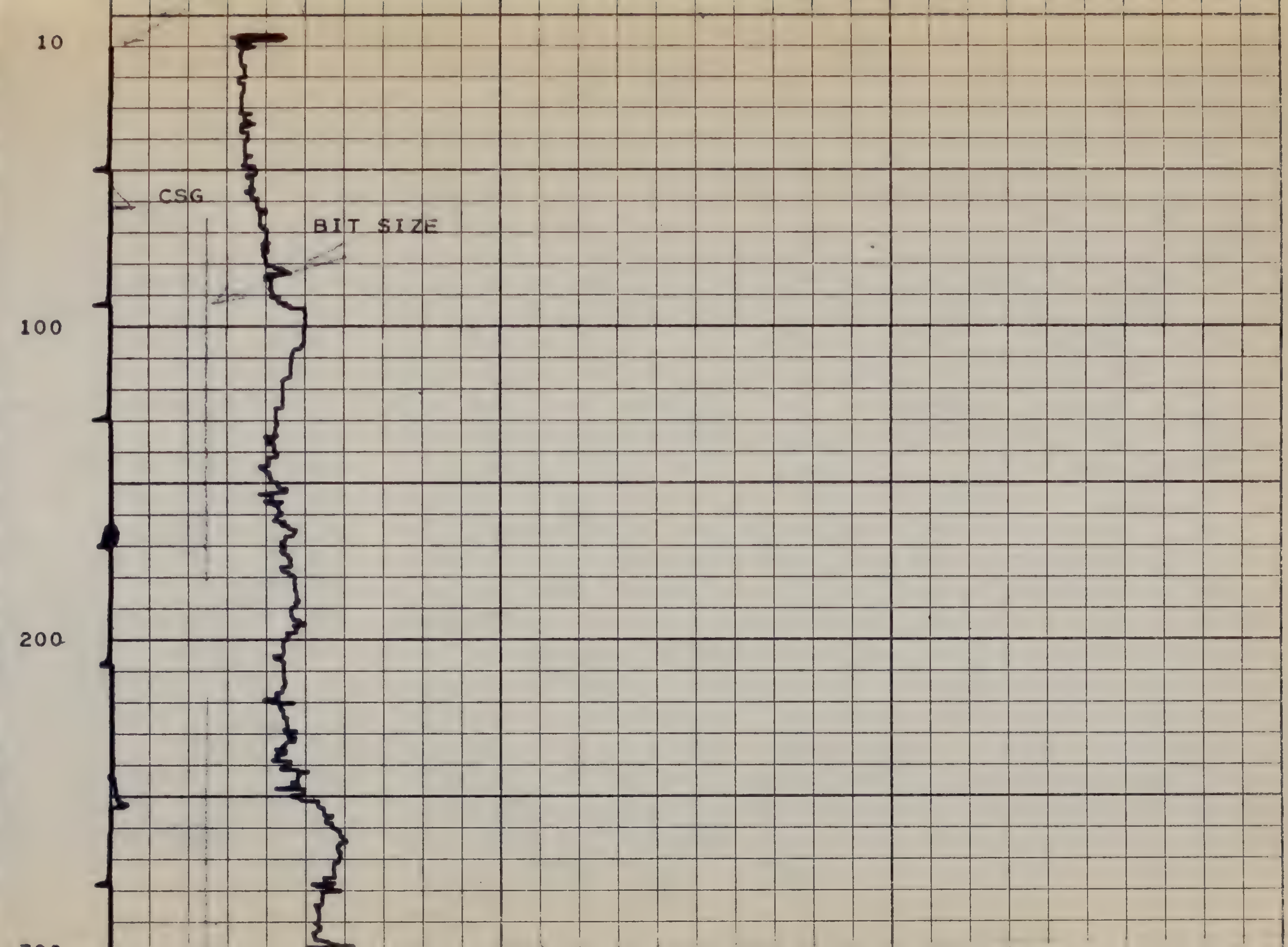
WELL DATA		
ORIGINAL TOTAL DEPTH		P.B.T.D.
TYPE WELL		
OPEN HOLE SHOT WITH		
AMOUNT	FM.	TO
AMOUNT	FM.	TO
AMOUNT	FM.	TO
SPECIAL WELL CONDITIONS:		
PURPOSE OF SURVEY		

REMARKS: (N.A. MEANS NOT AVAILABLE)

DEPTHS	HOLE DIAMETER IN INCHES
	5 10 15 20

INTEGRATED HOLE VOLUME

10 CU.FT./PIP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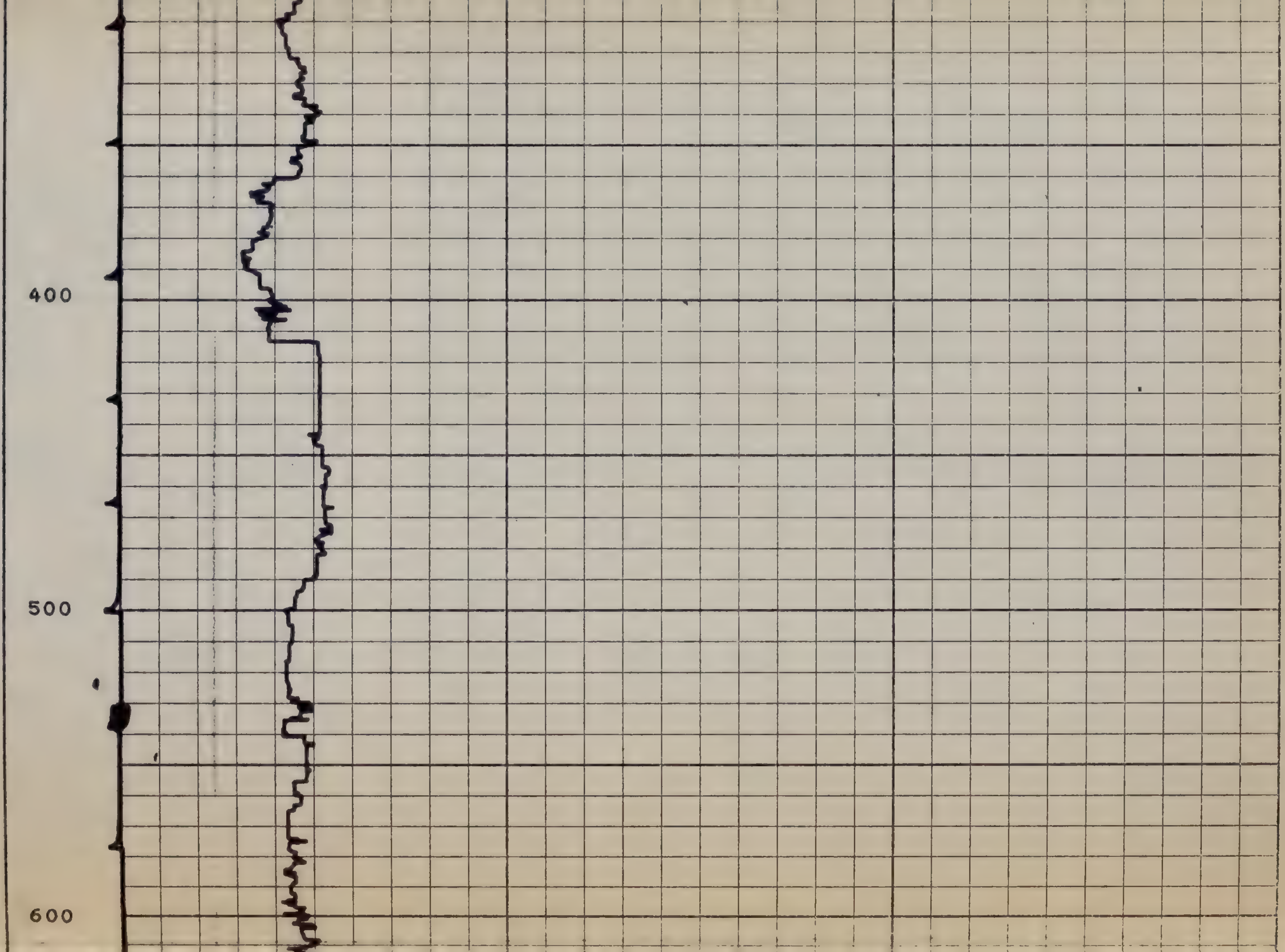
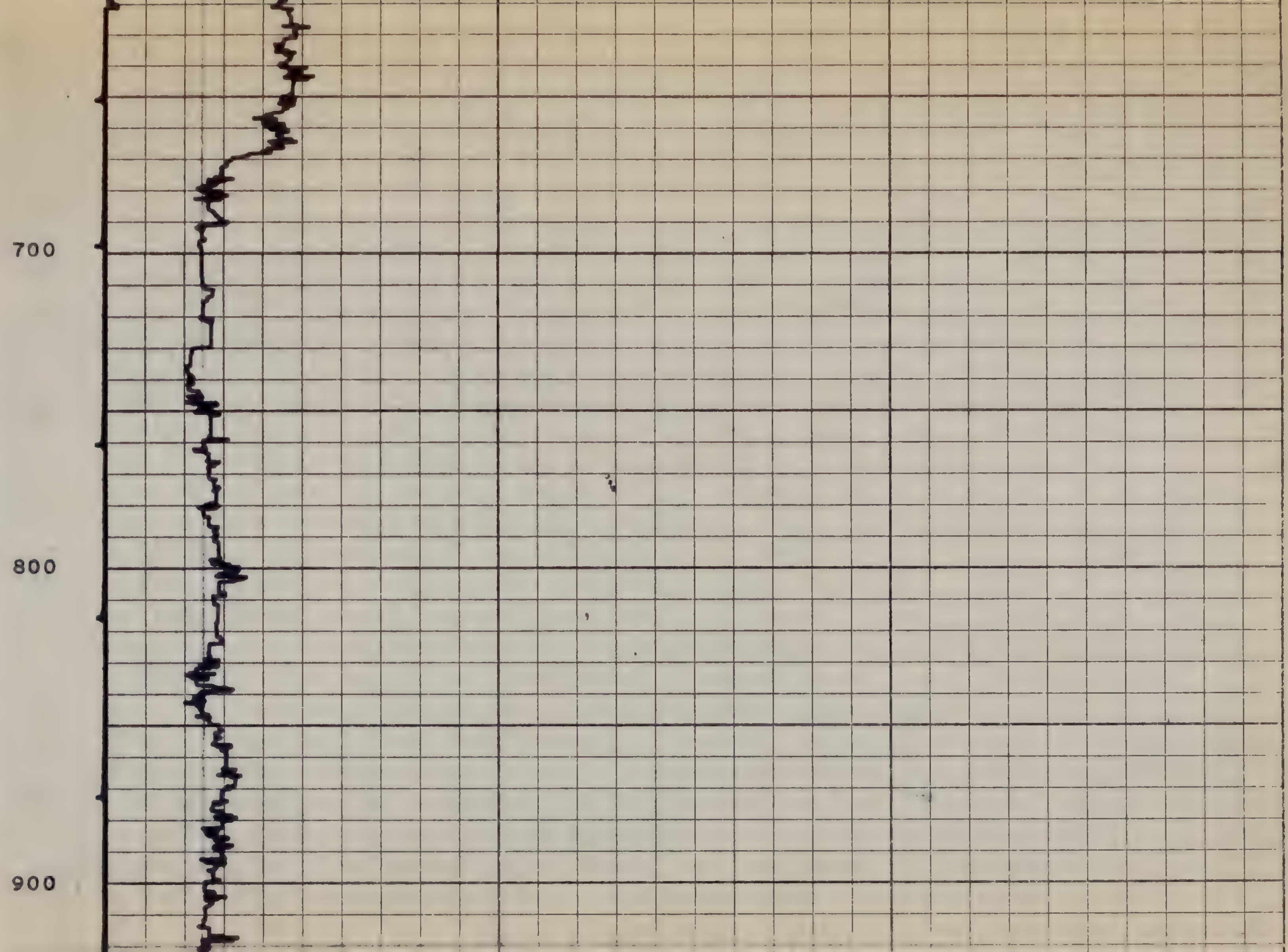
CSG
BIT SIZE
100
200


400
500
600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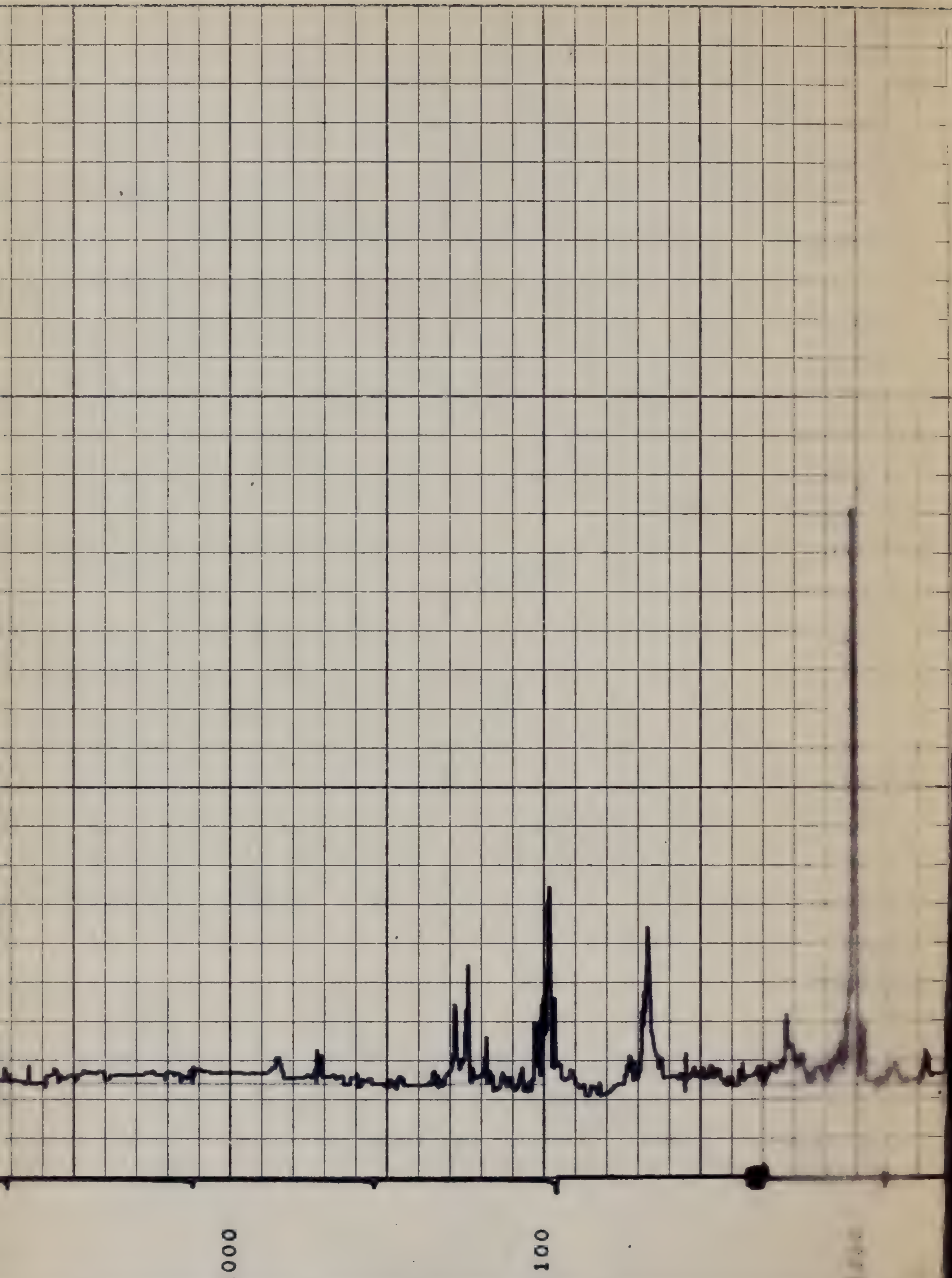
800
900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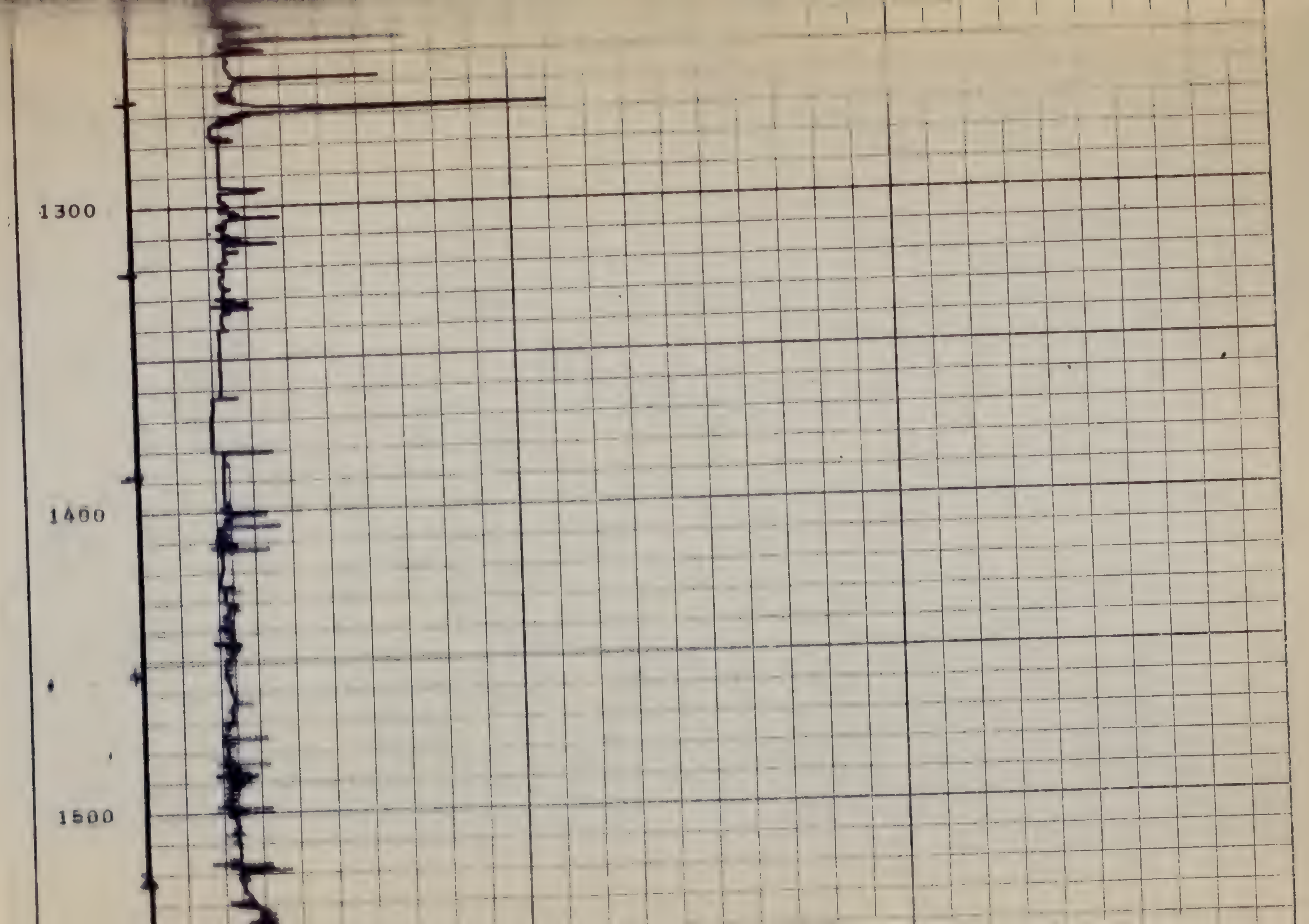
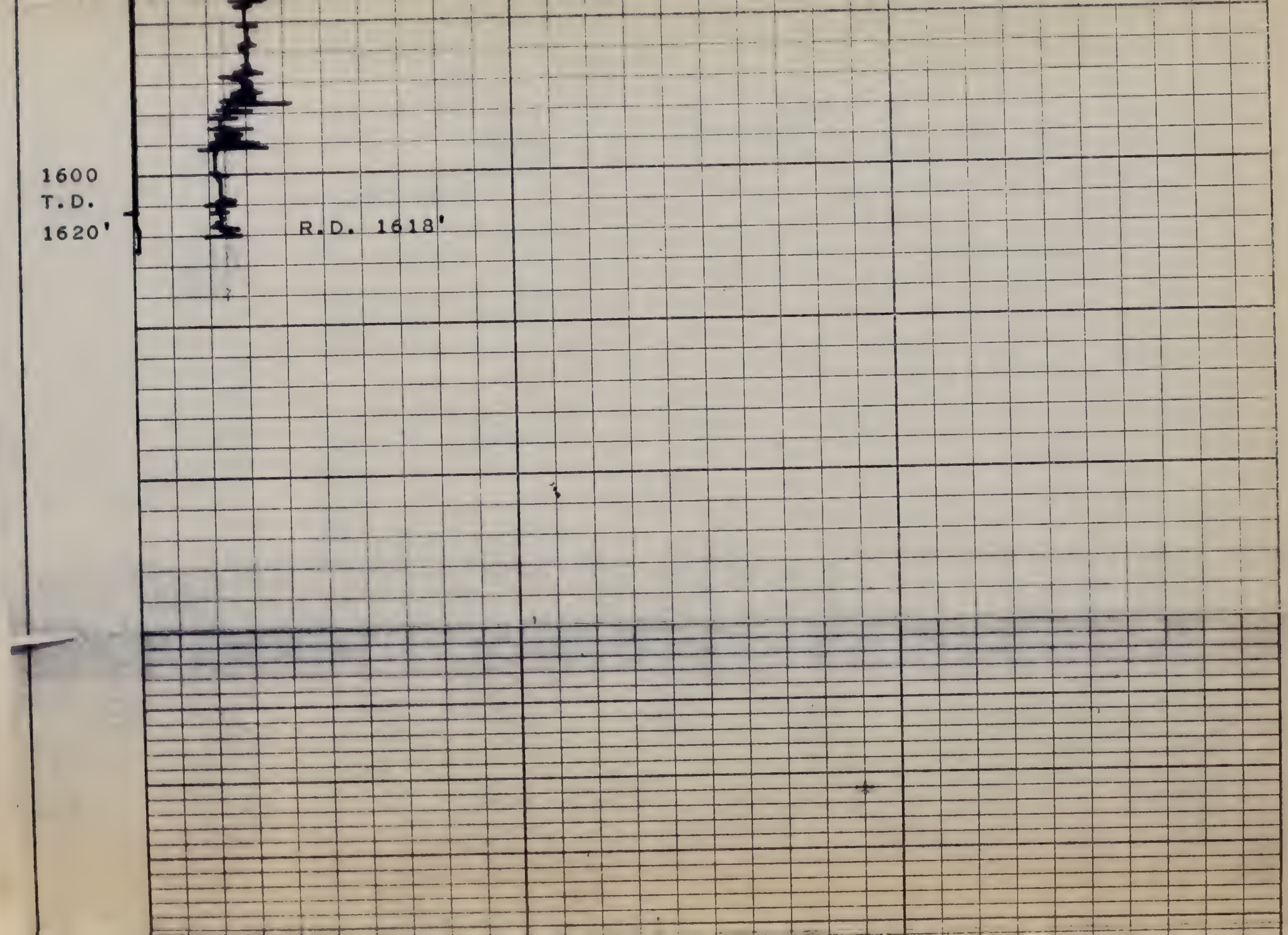
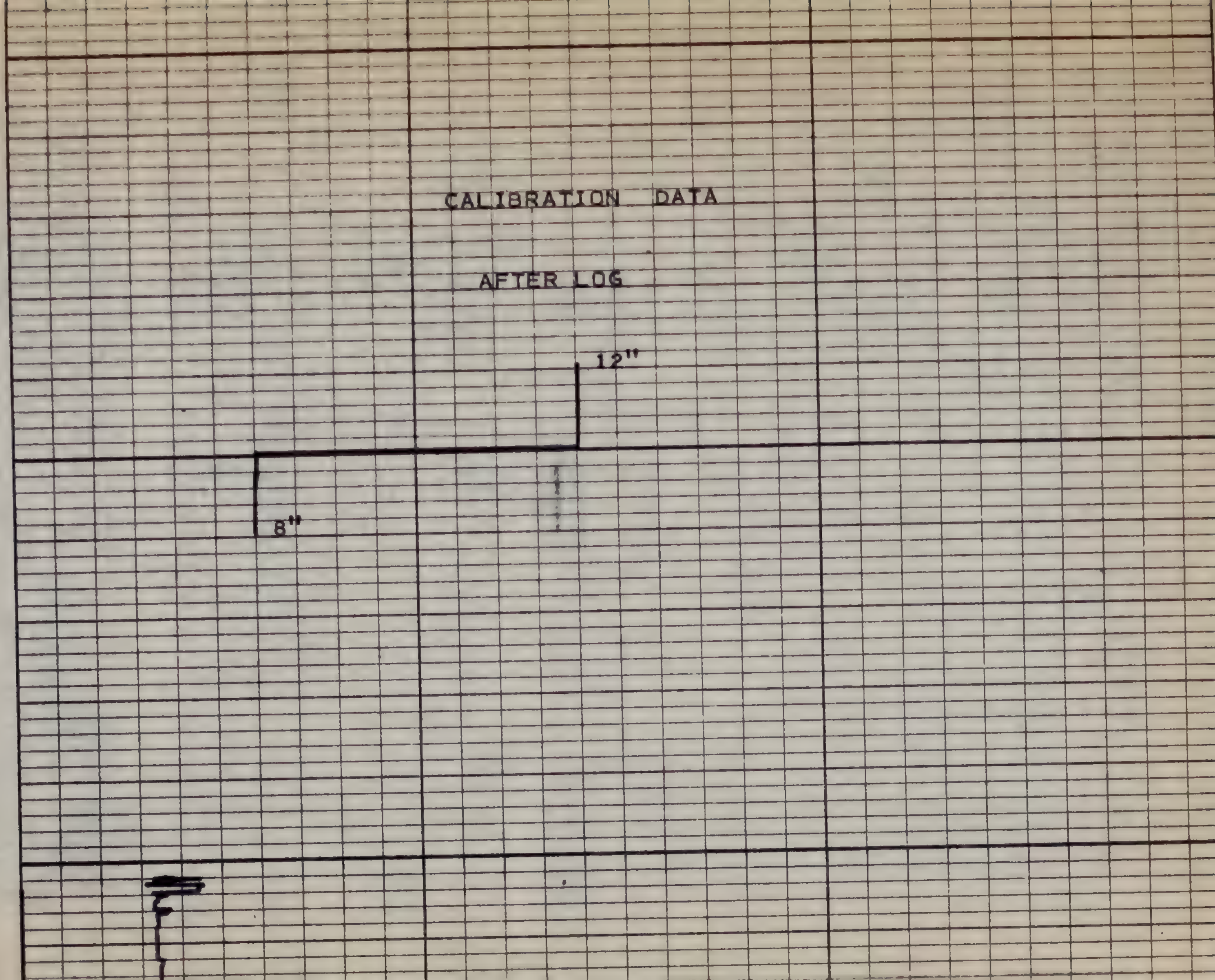
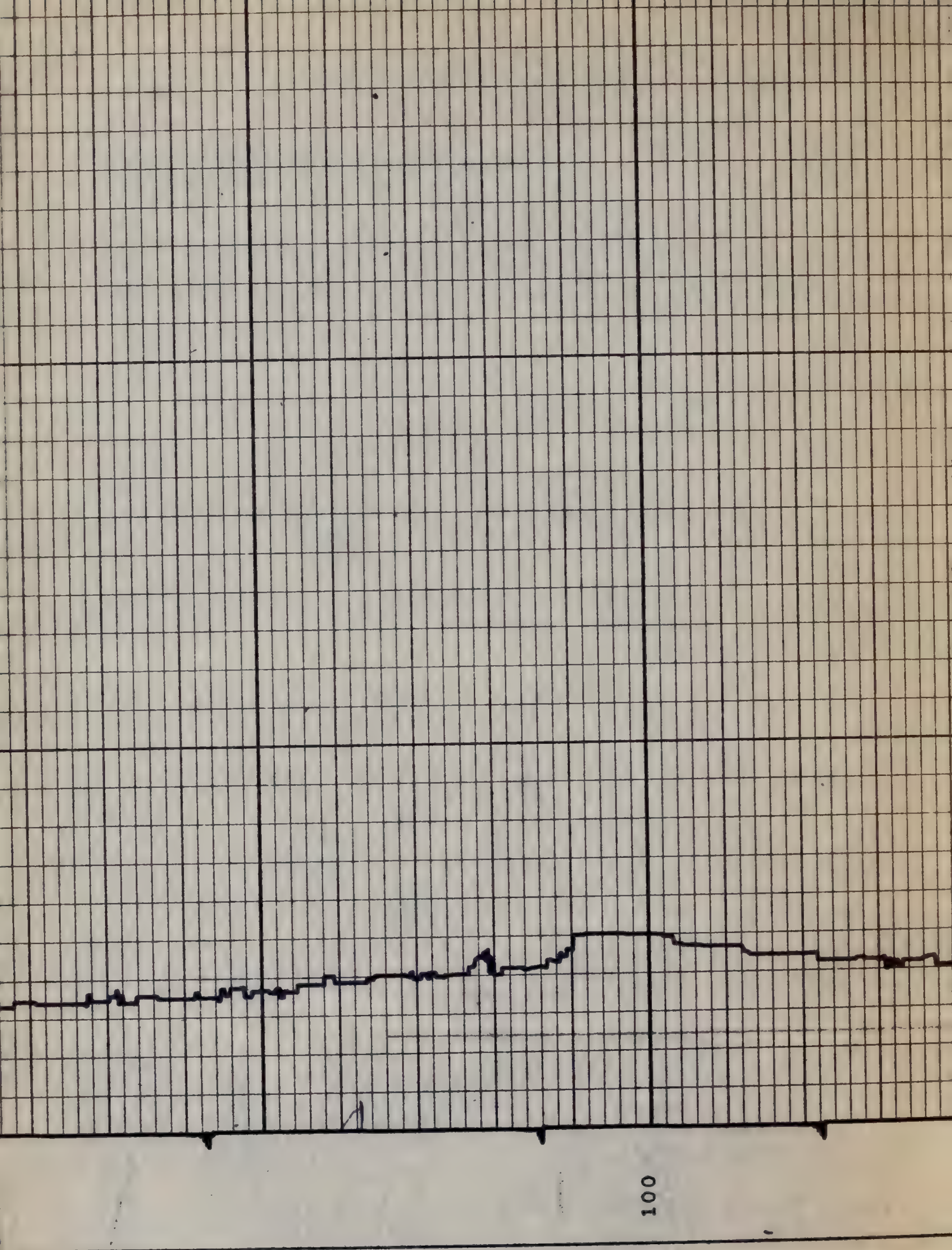
1100


1300
1400
1500


1600
T.D.
1620'
R.D. 1618'



10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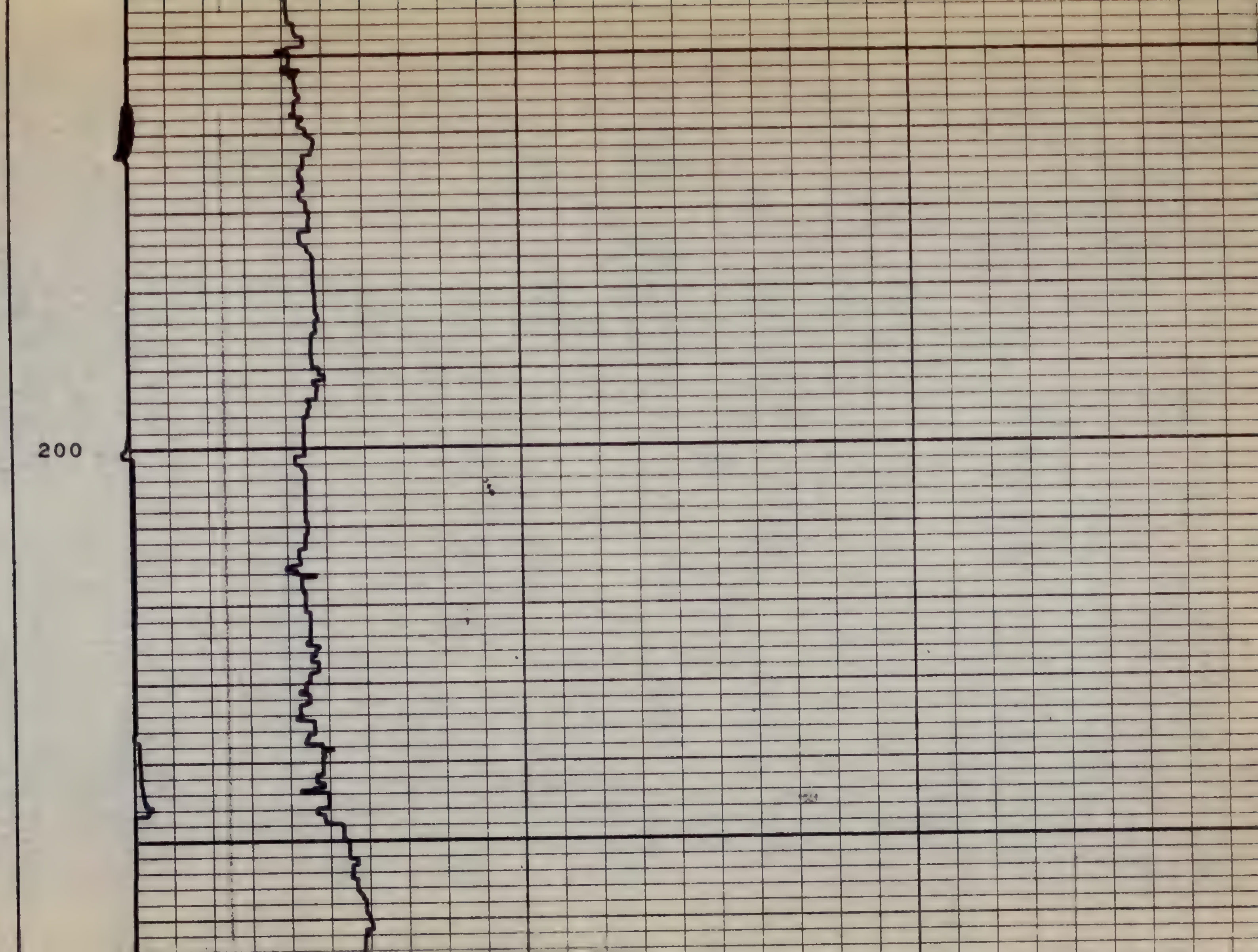
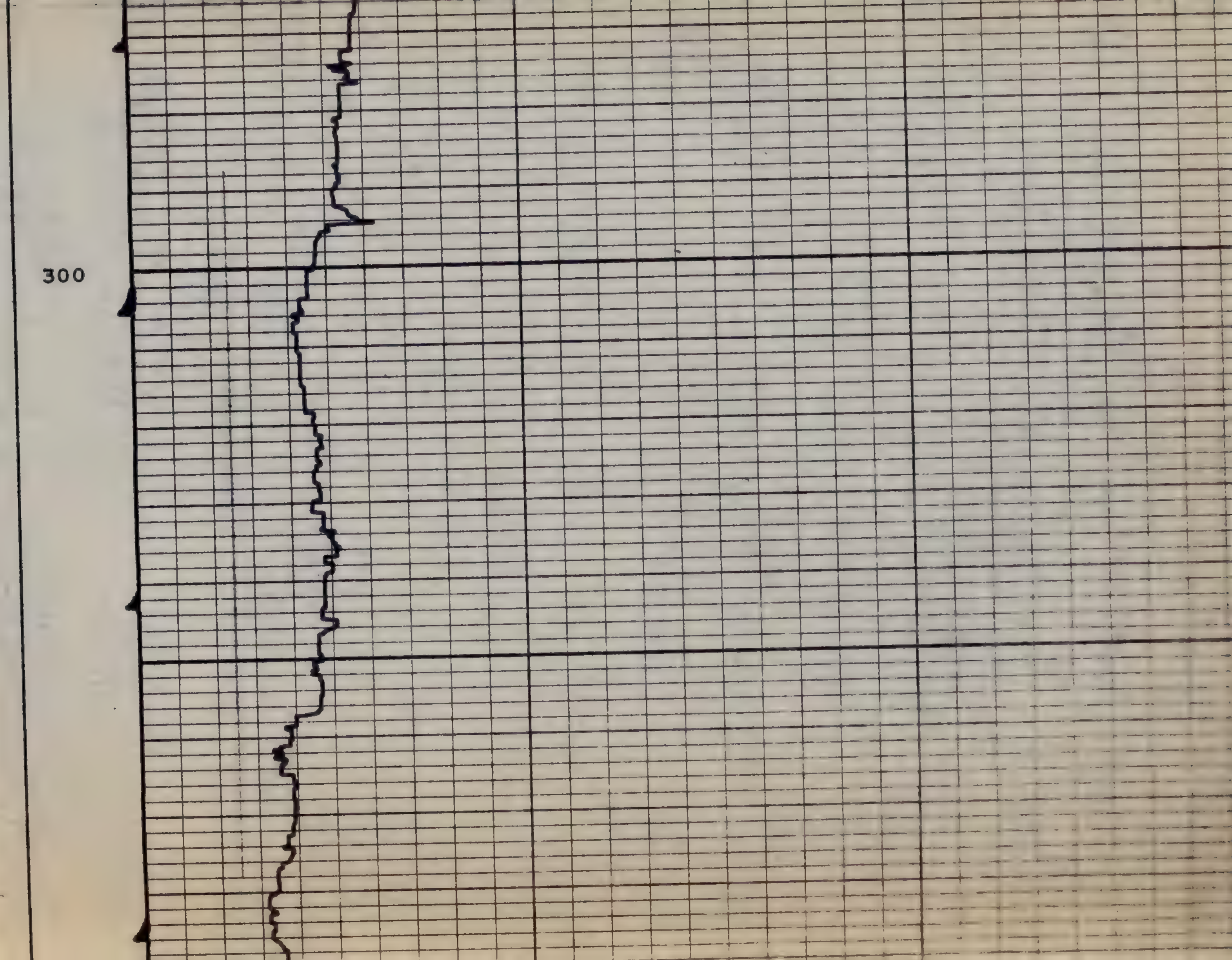

200



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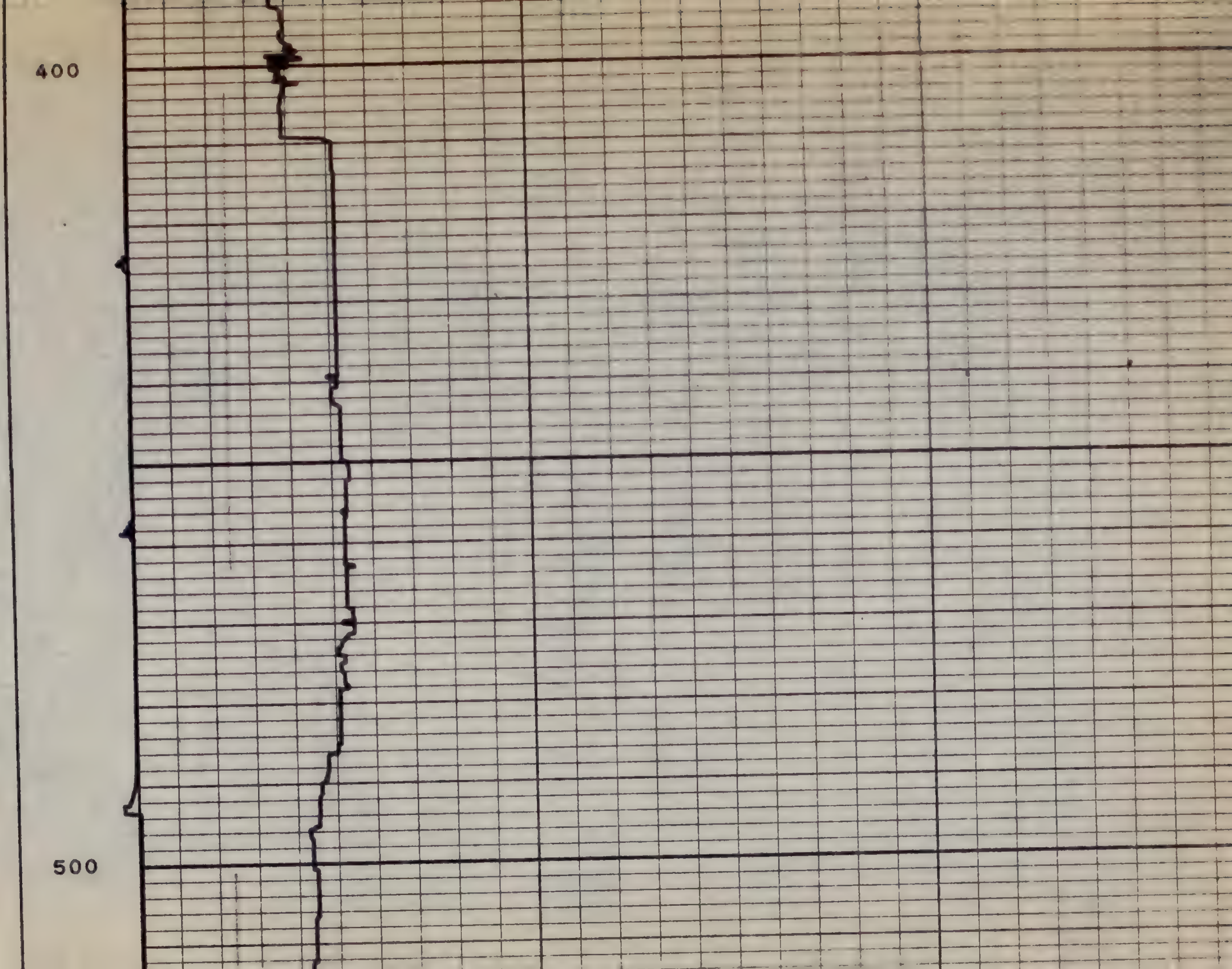
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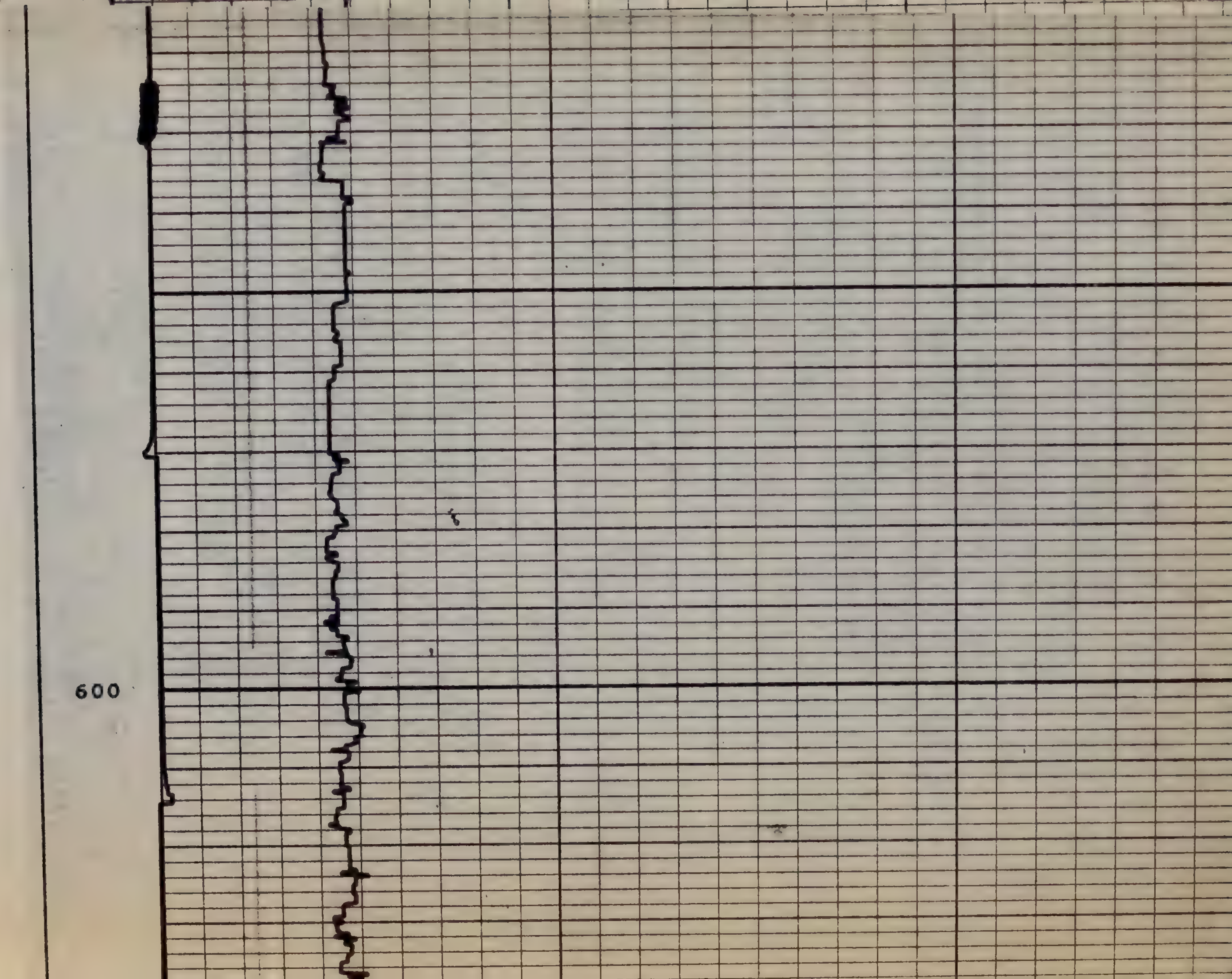
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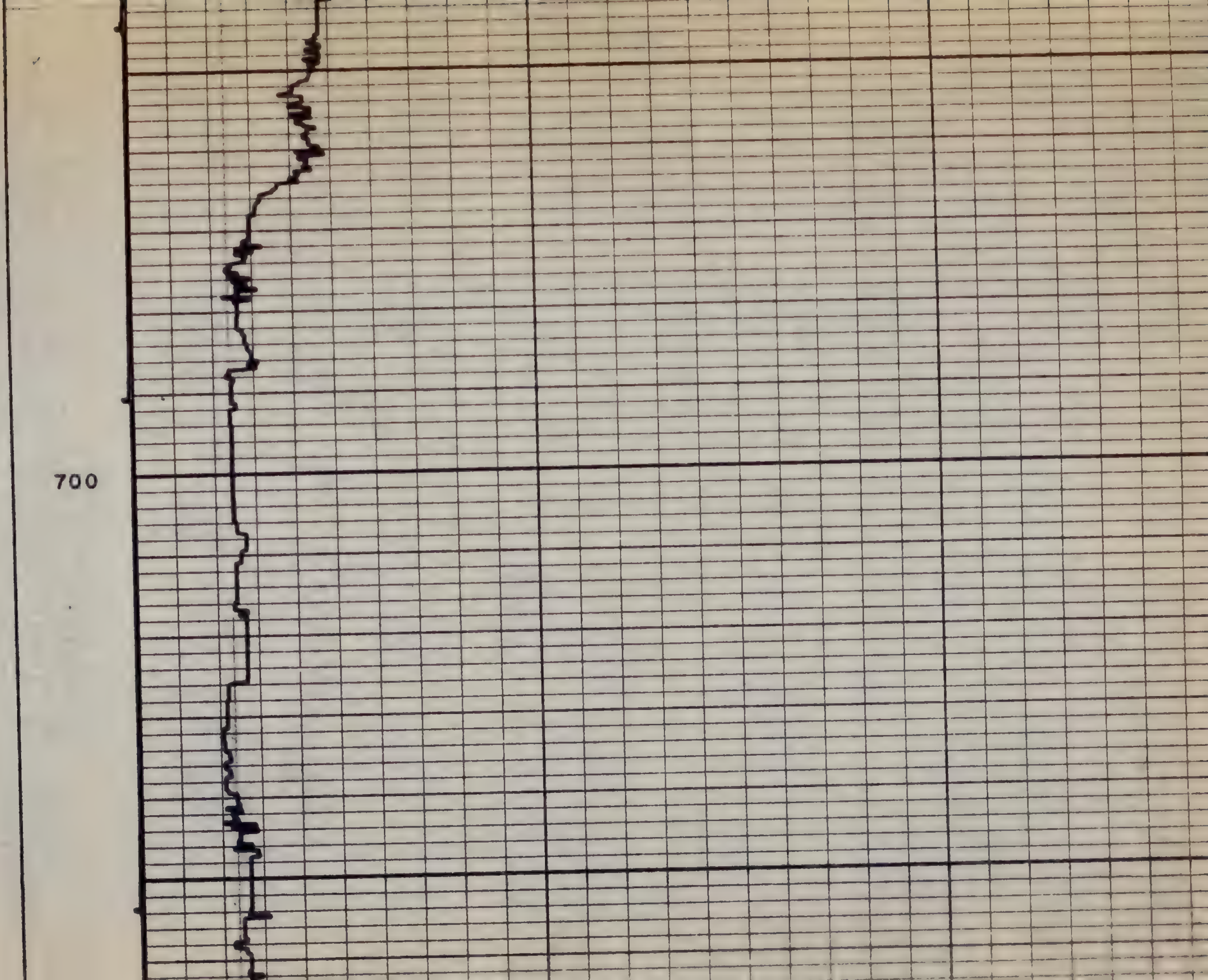
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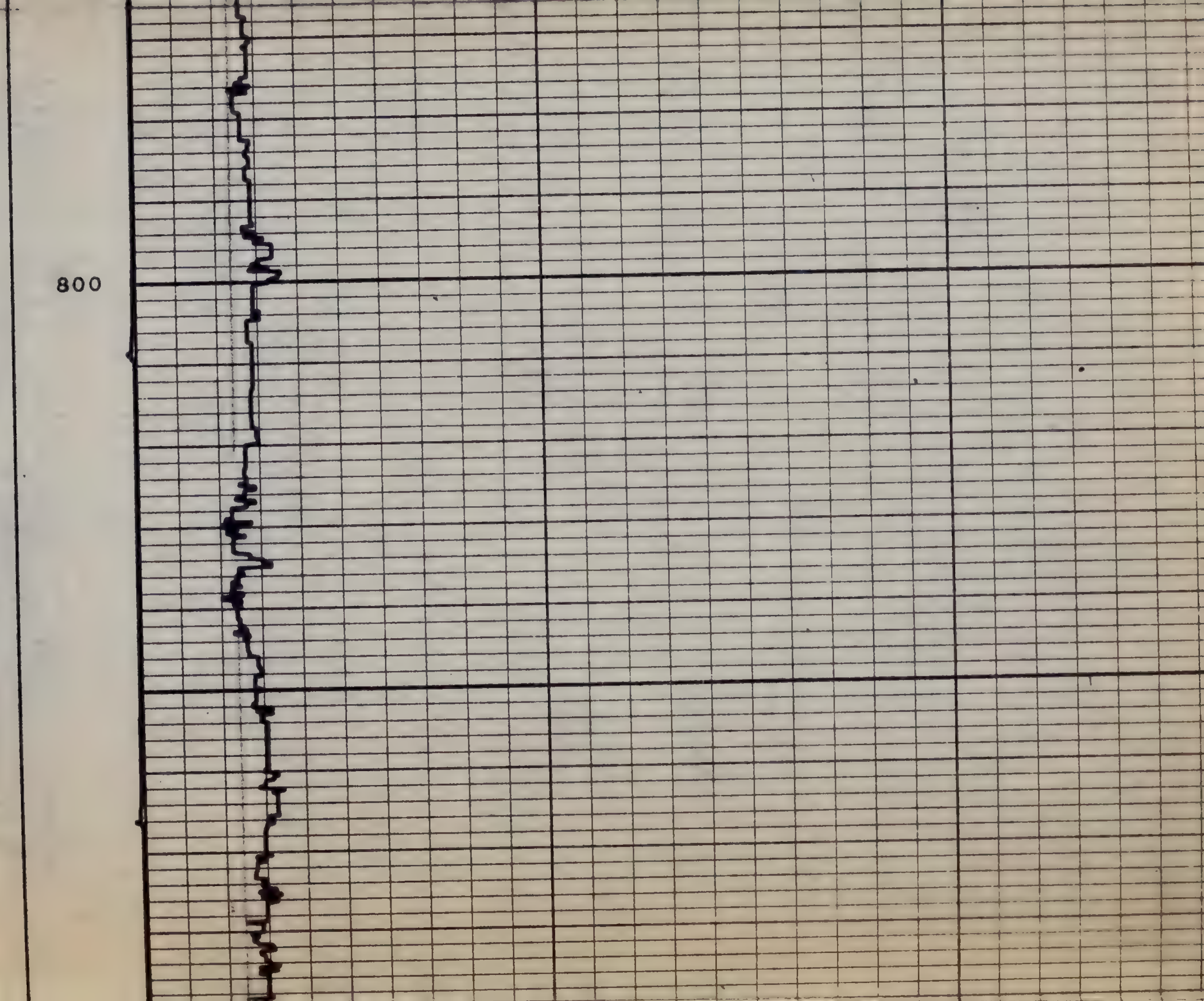
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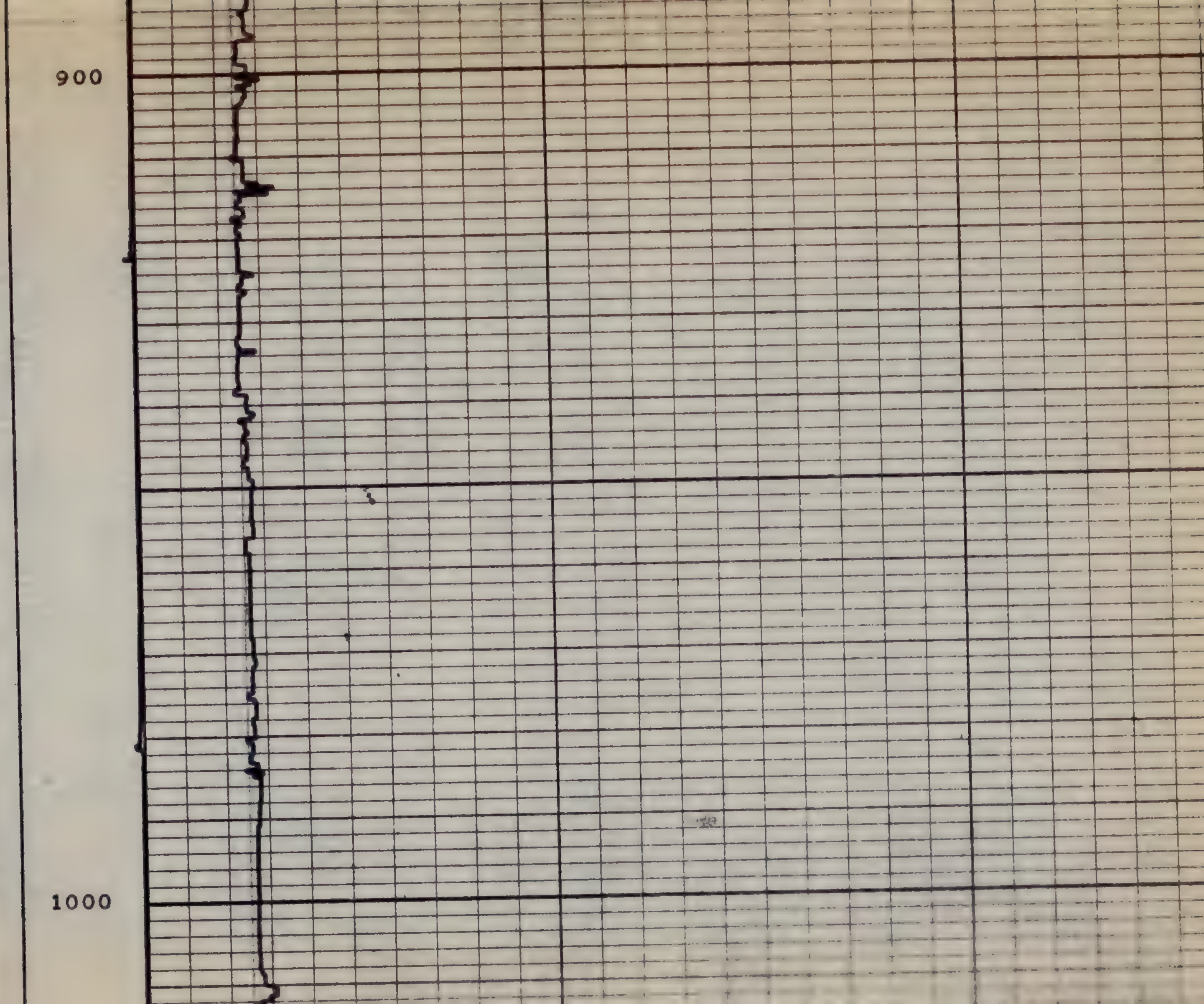
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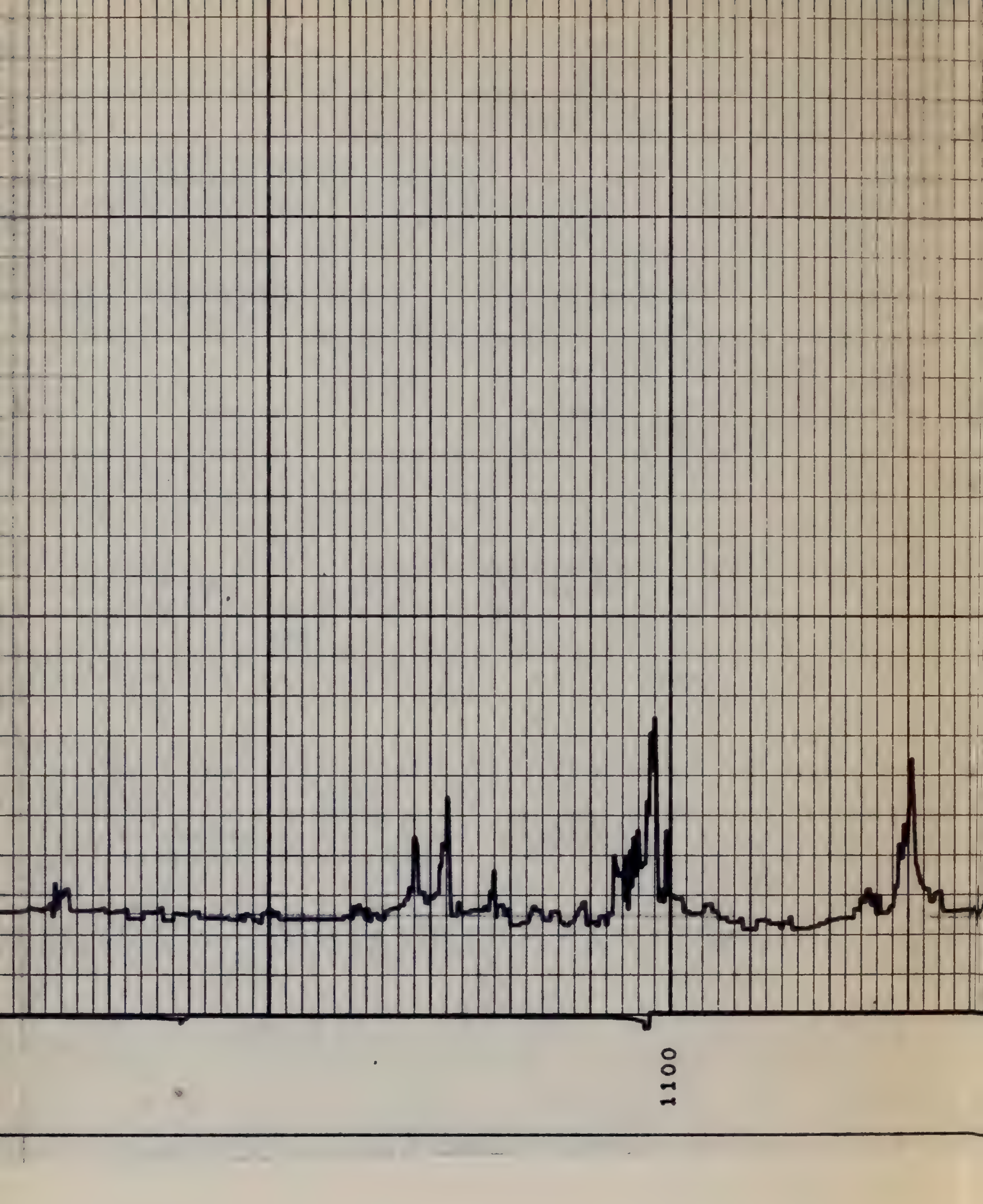
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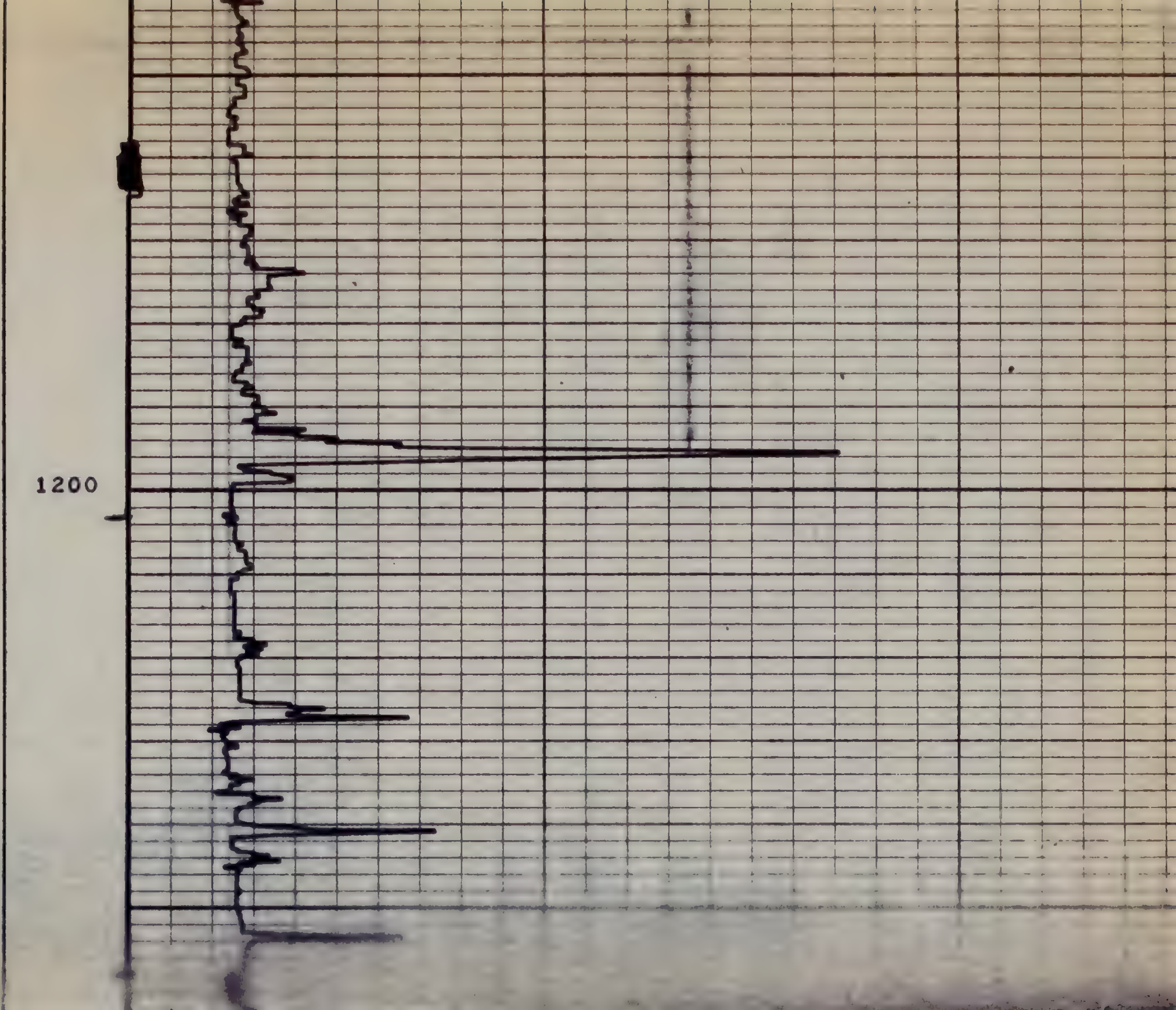
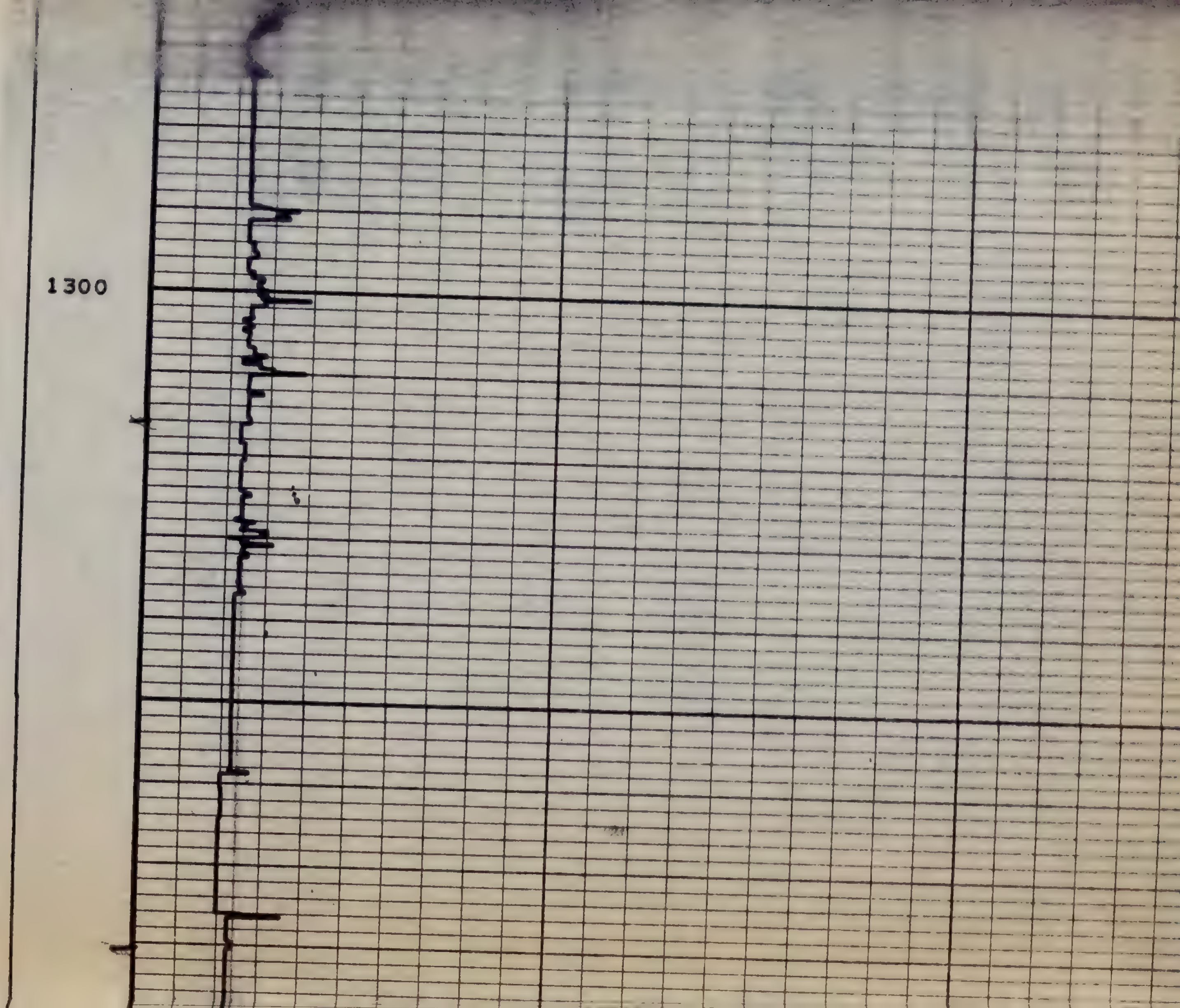
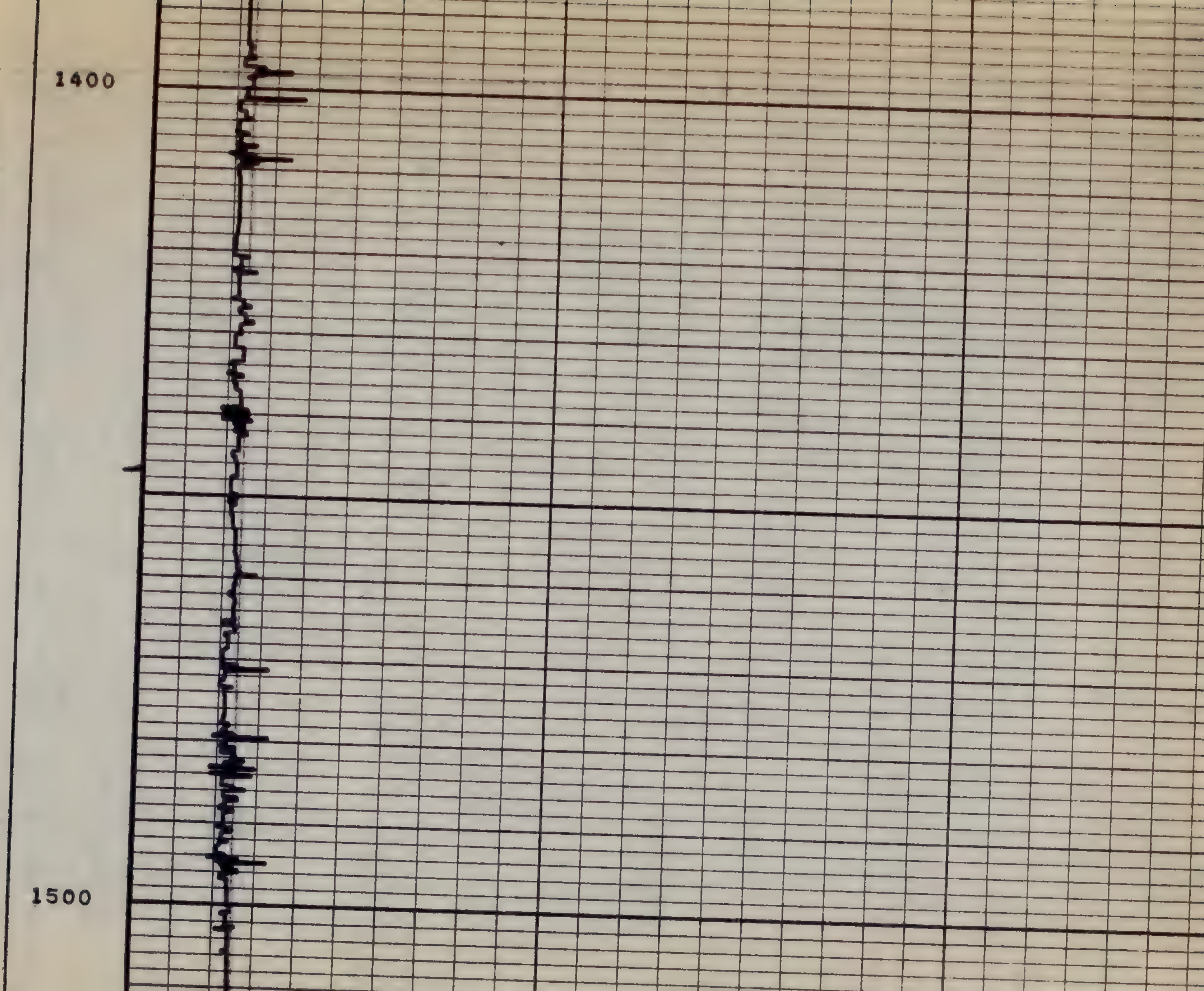
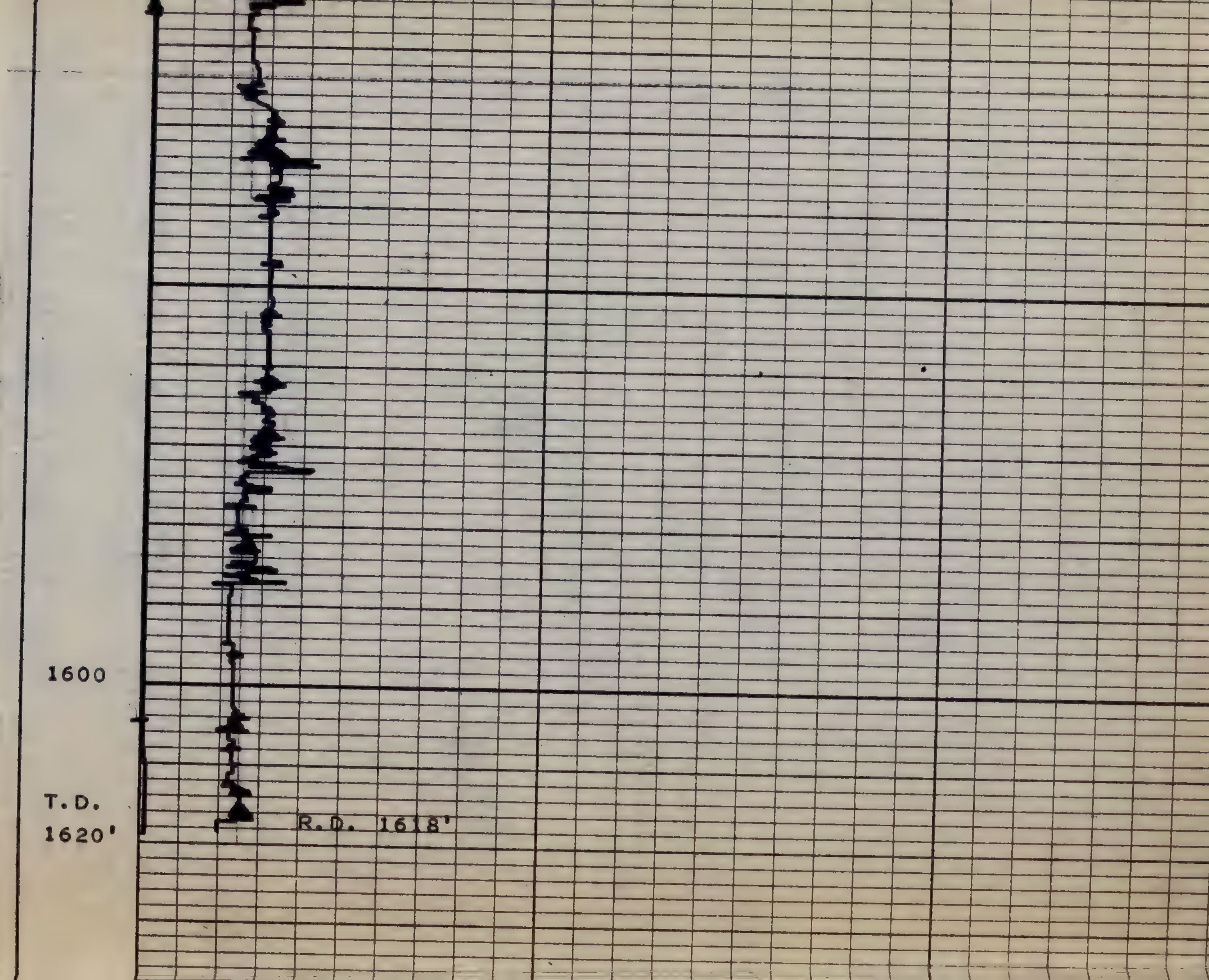
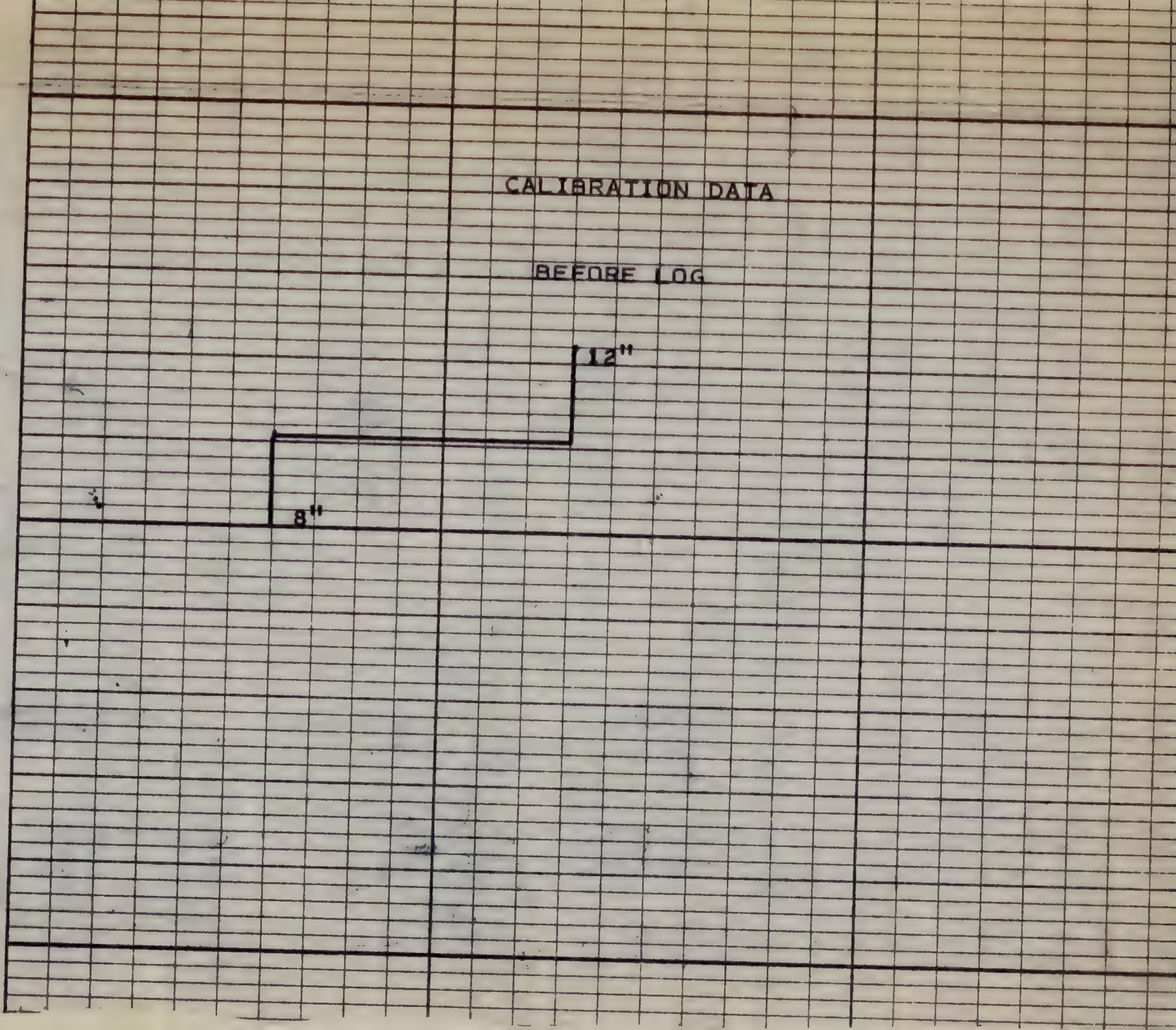

1200


1300


1400
1500


1600
T.D.
1620'
R.D. 1618'


CALIBRATION DATA
BEFORE LOG
12"
8"

Birdwell

Temperature Log

FILING NO.

COMPANY ATLANTIC RICHFIELD COMPANY, ET. AL.

WELL SORGHUM GULCH AQUIFER 1-A

FIELD

COUNTY RIO BLANCO **STATE** COLORADO

LOCATION:

SEC. 7 TWP. 3S RGE. 96W

OTHER SERVICES:

V3D CAL FDL
GR/ENP ES

ELEVATIONS:

KB.
DF.
GL. 6909'

PERMANENT DATUM GROUND LEVEL **ELEV.** 6909'
LOG MEASURED FROM GL
DRILLING MEASURED FROM GL

DATE	2 JULY 74		
RUN NO.	1		
TYPE LOG	TL		
DEPTH—DRILLER	1621		
DEPTH—LOGGER	1620		
BOTTOM LOGGED INTERVAL	1618		
TOP LOGGED INTERVAL	430		
TYPE FLUID IN HOLE	WATER		
SALINITY PPM CL.			
DENSITY LB./GAL.			
LEVEL	412		
MAX. REC. TEMP.—DEG. F.	78°		
OPR. RIG TIME	1/2 HR.		
RECORDED BY	WILSON		
WITNESSED BY	TAIT		
LOCATION	LAS VEGAS		

RUN NO.	BORE HOLE RECORD			CASING RECORD			
	BIT	FROM	TO	SIZE	WGT.	FROM	TO
1				7"		0	62'
	6-1/4"	62'	1621'				

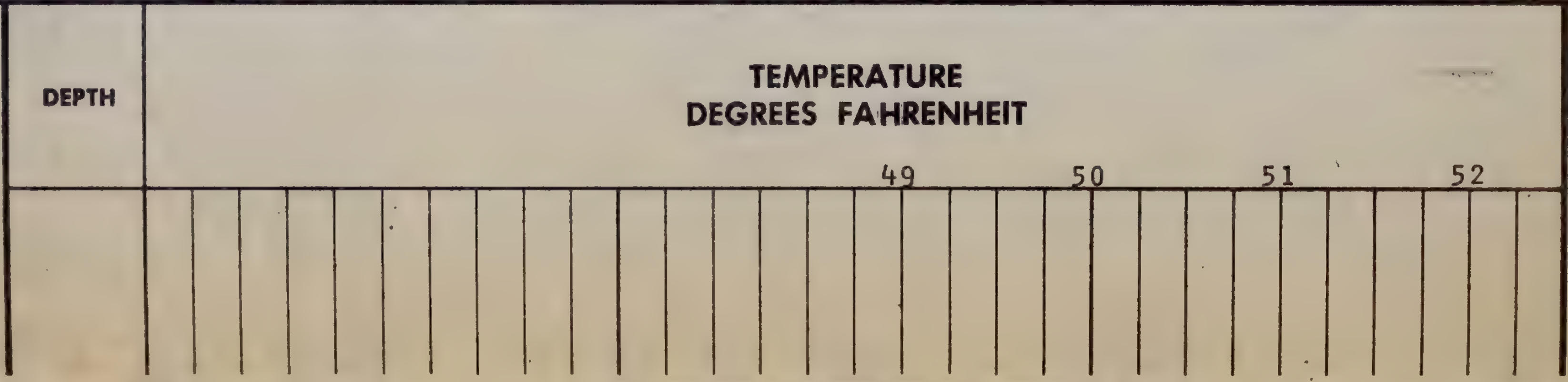
EQUIPMENT DATA			
TYPE LOG	TL		
RUN NO.	1		
TOOL MODEL NO.	LDAH-6010		
DIAM.	3-5/8"		
SPEED FT./MIN.	60		
T. C. - SEC.	1		
SCALE	1/4°/DIV.		

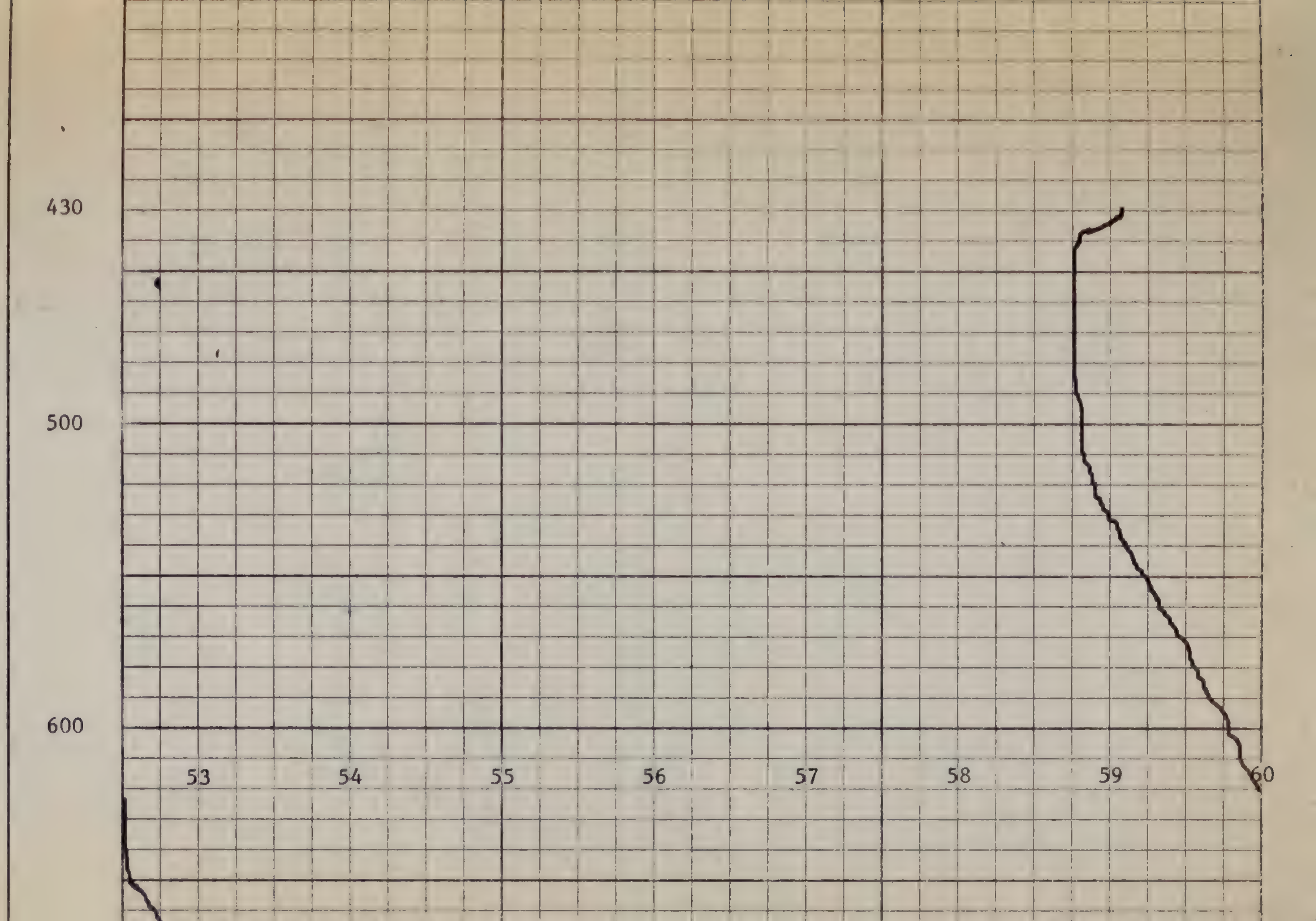
GENERAL			
HOIST TRUCK NO.	2694		
INST. TRUCK NO.	2694		
TOOL SERIAL NO.			

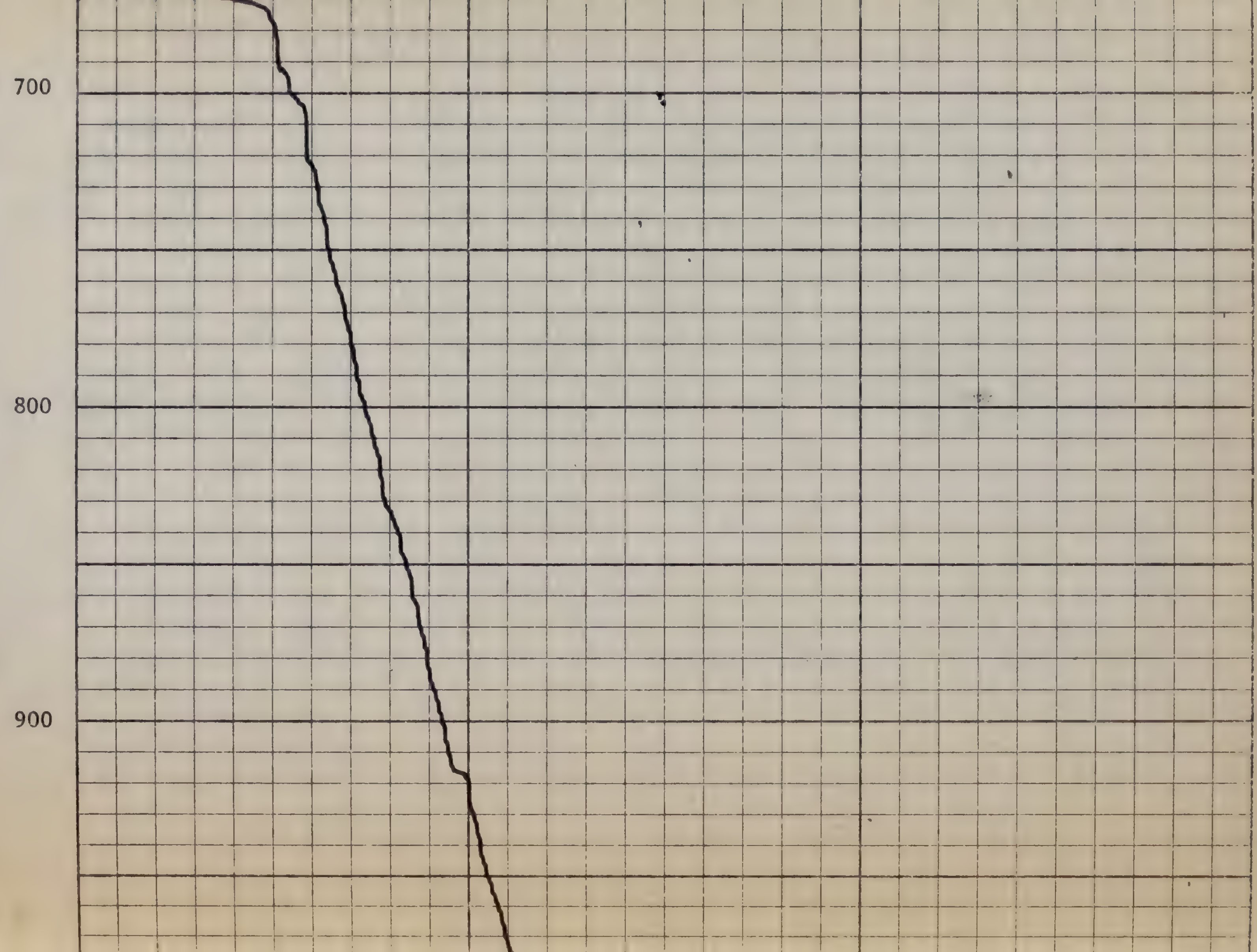
WELL DATA			
TYPE WELL			
RUN NO.			
PROD. OR INJ. RATE			
WELL HEAD PRESSURE			
TYPE & AMT. CEMENT			
LENGTH OF TIME:			
PROD. OR INJECTING			
SHUT IN			
SINCE CEMENTING			

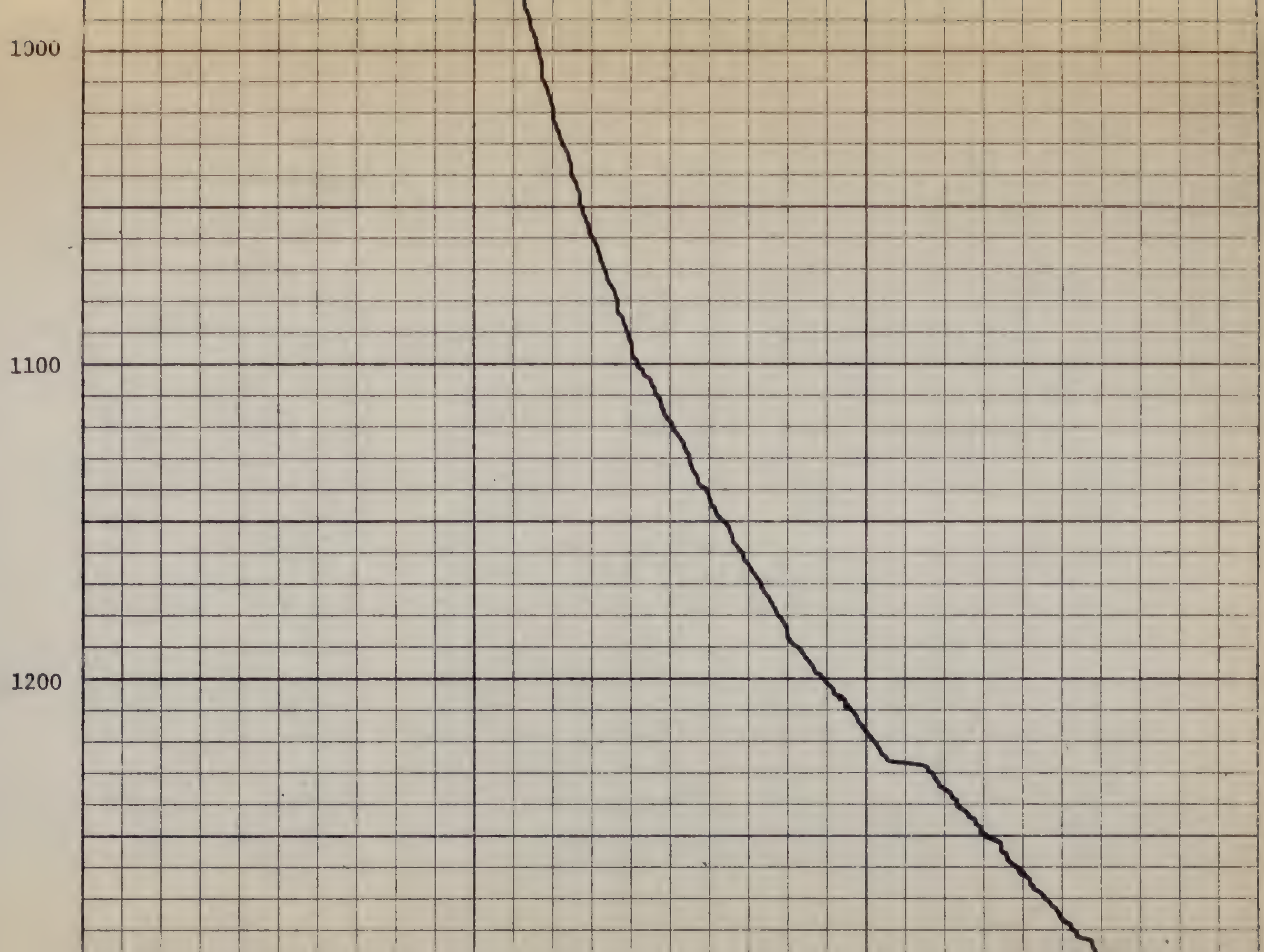
PURPOSE OF SURVEY

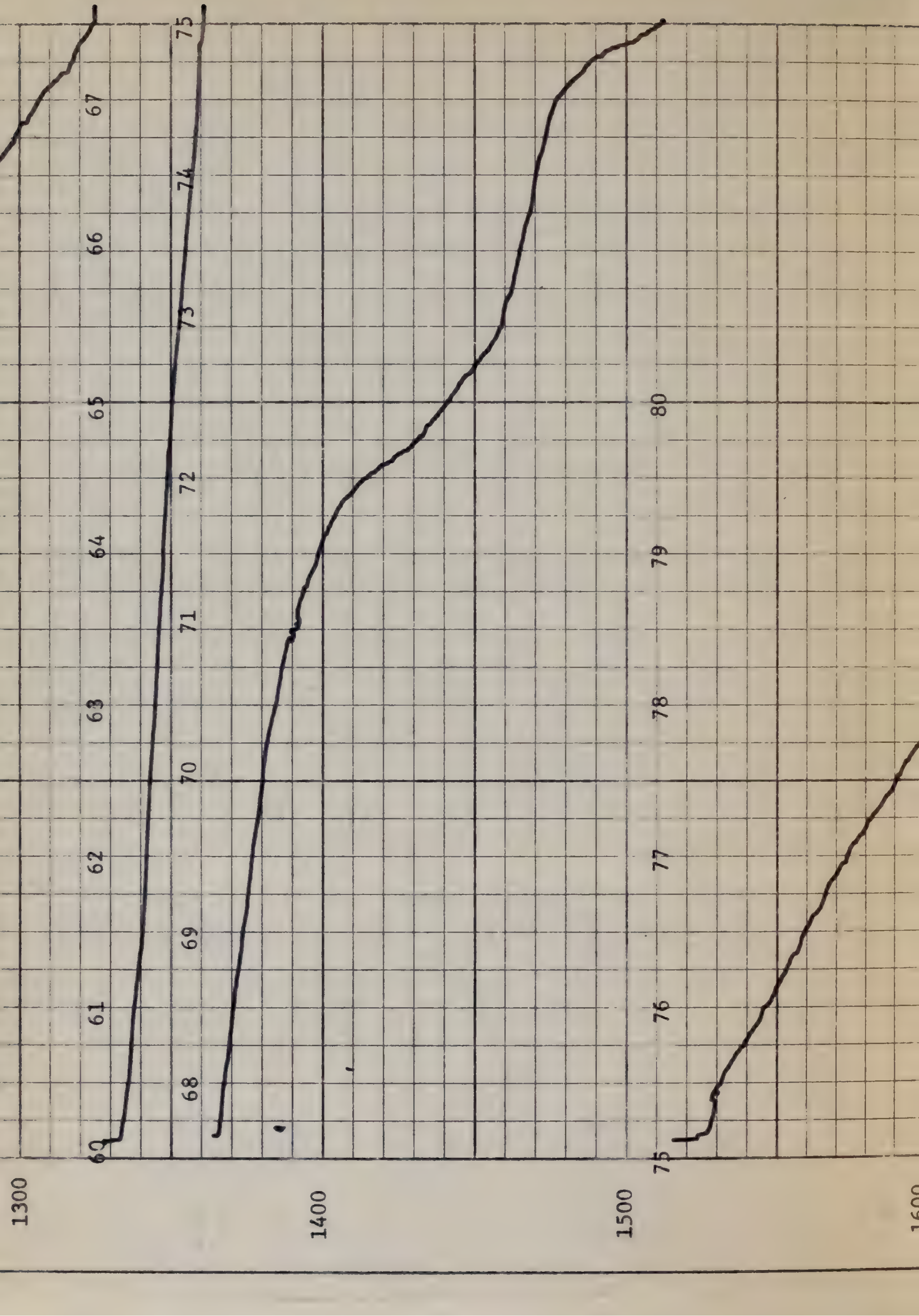
REMARKS: N.A. Means not available




430
500
600
53
54
55
56
57
58
59
60

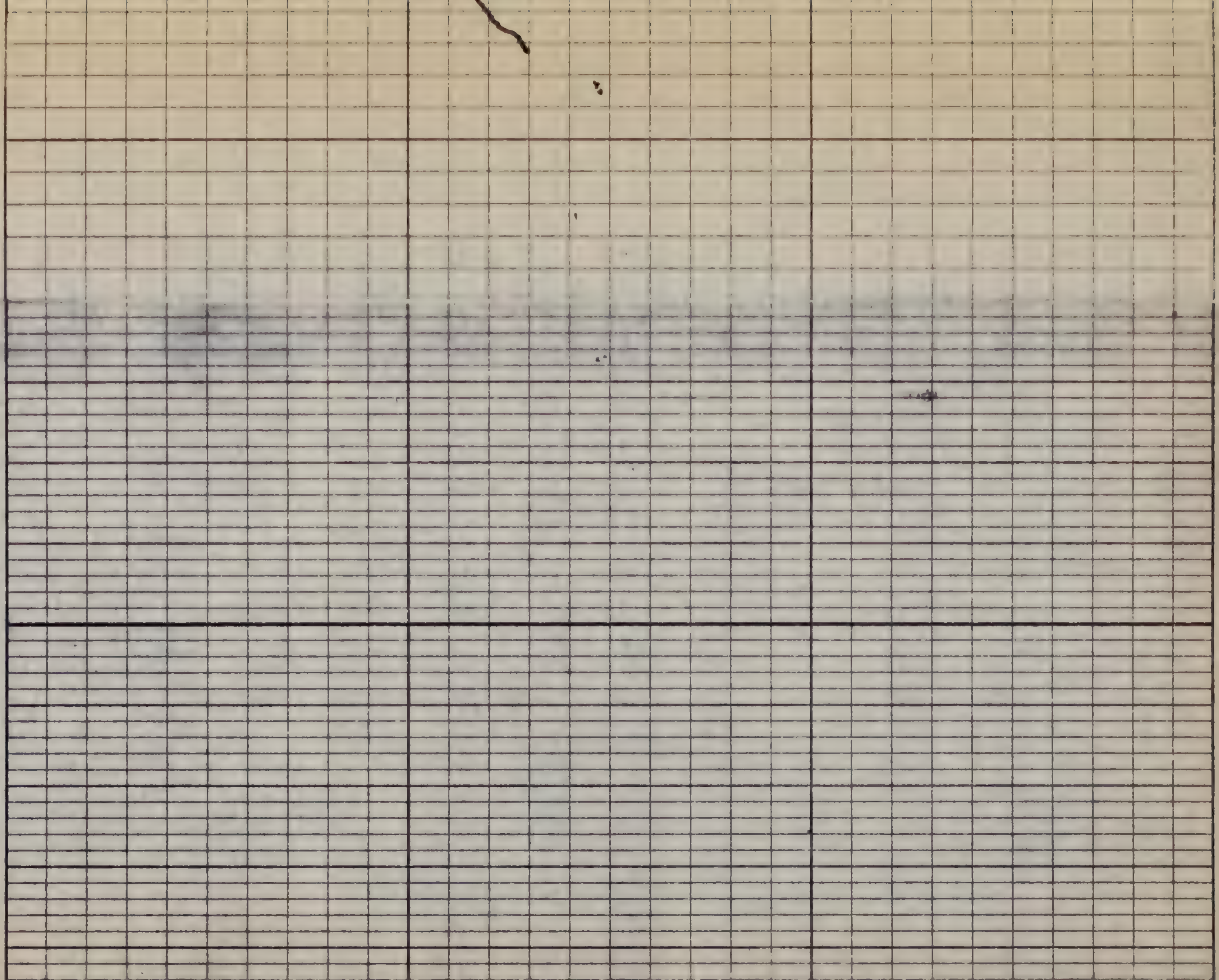

700
800
900

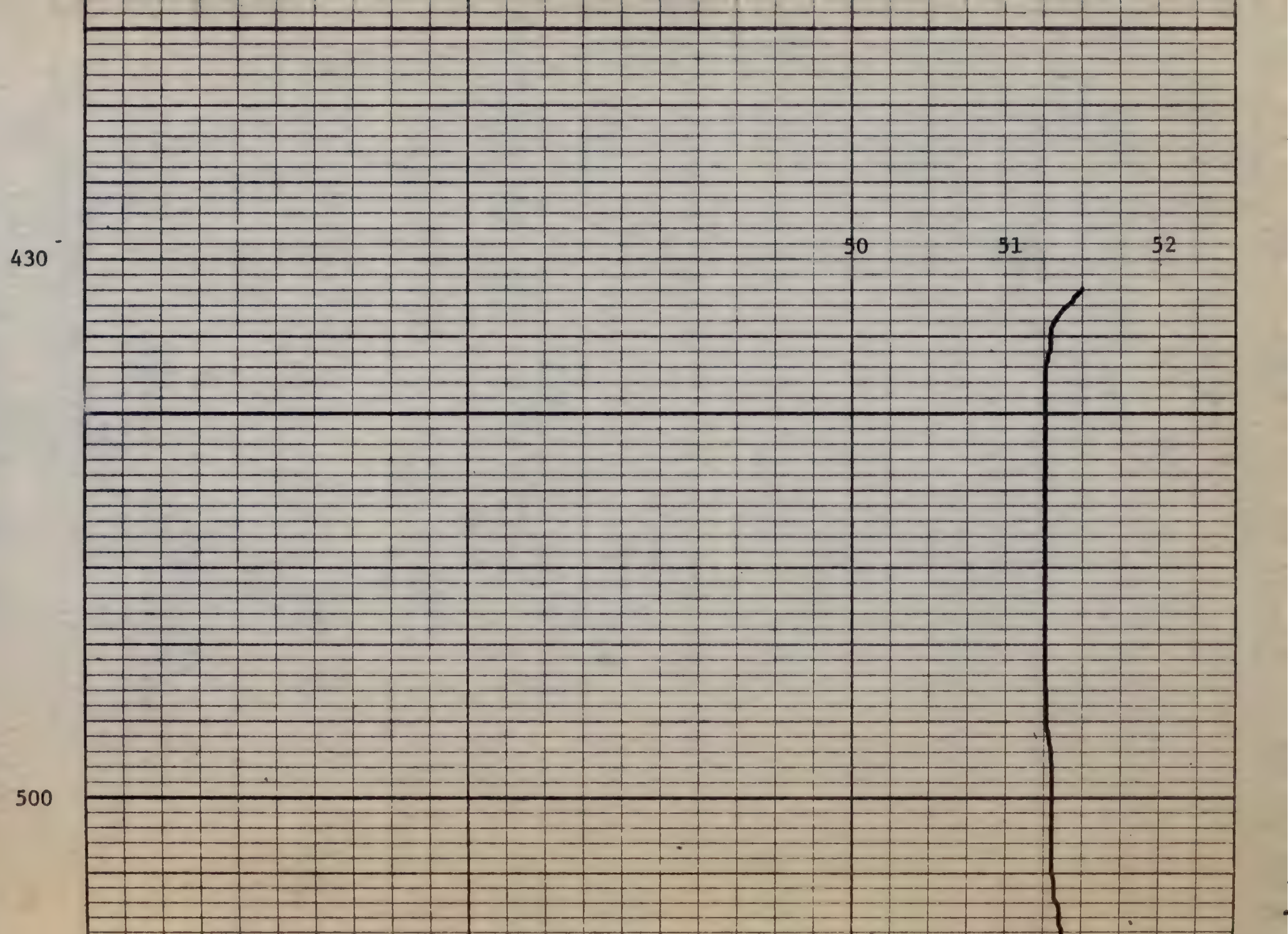

1000
1100
1200

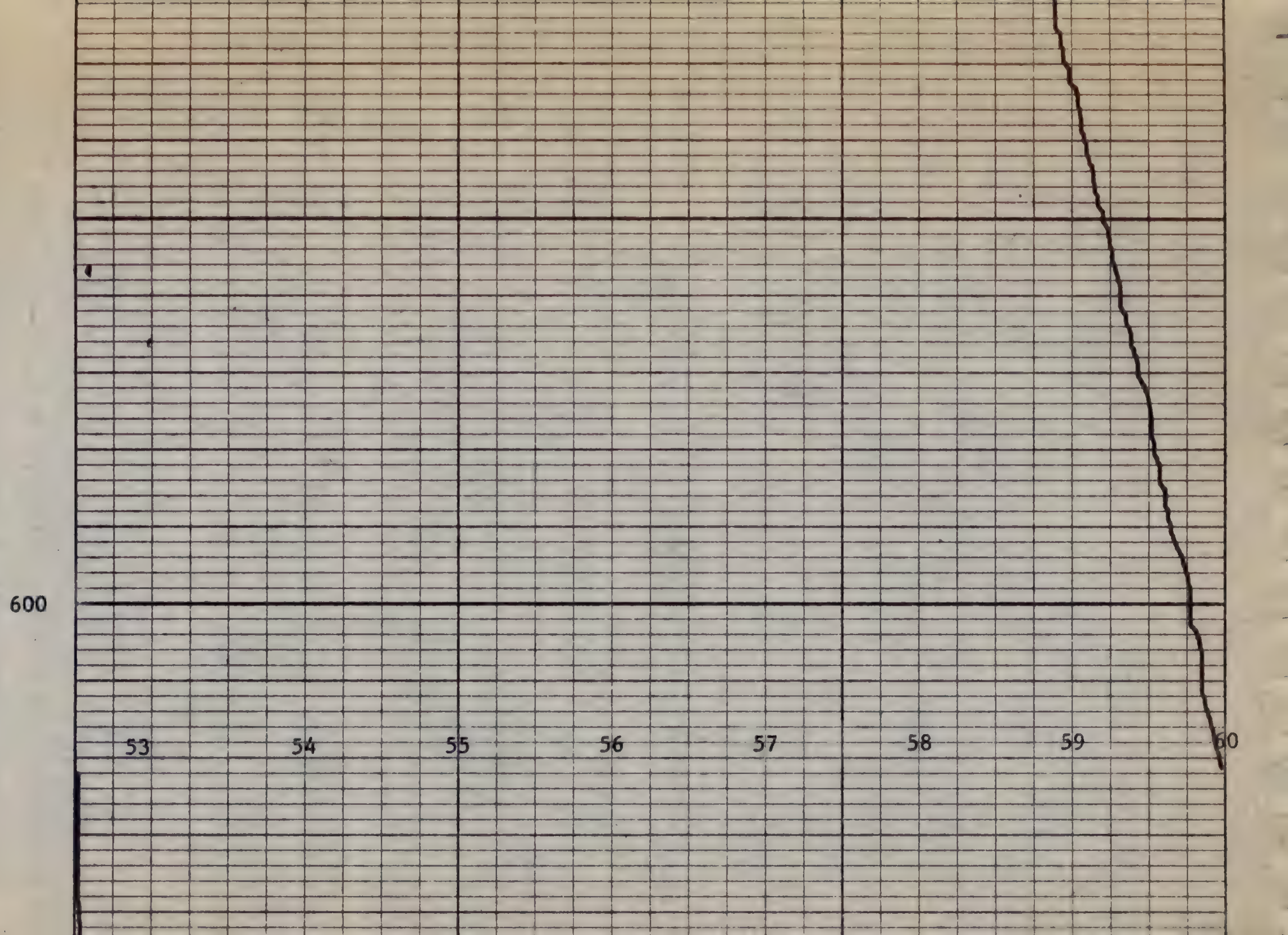


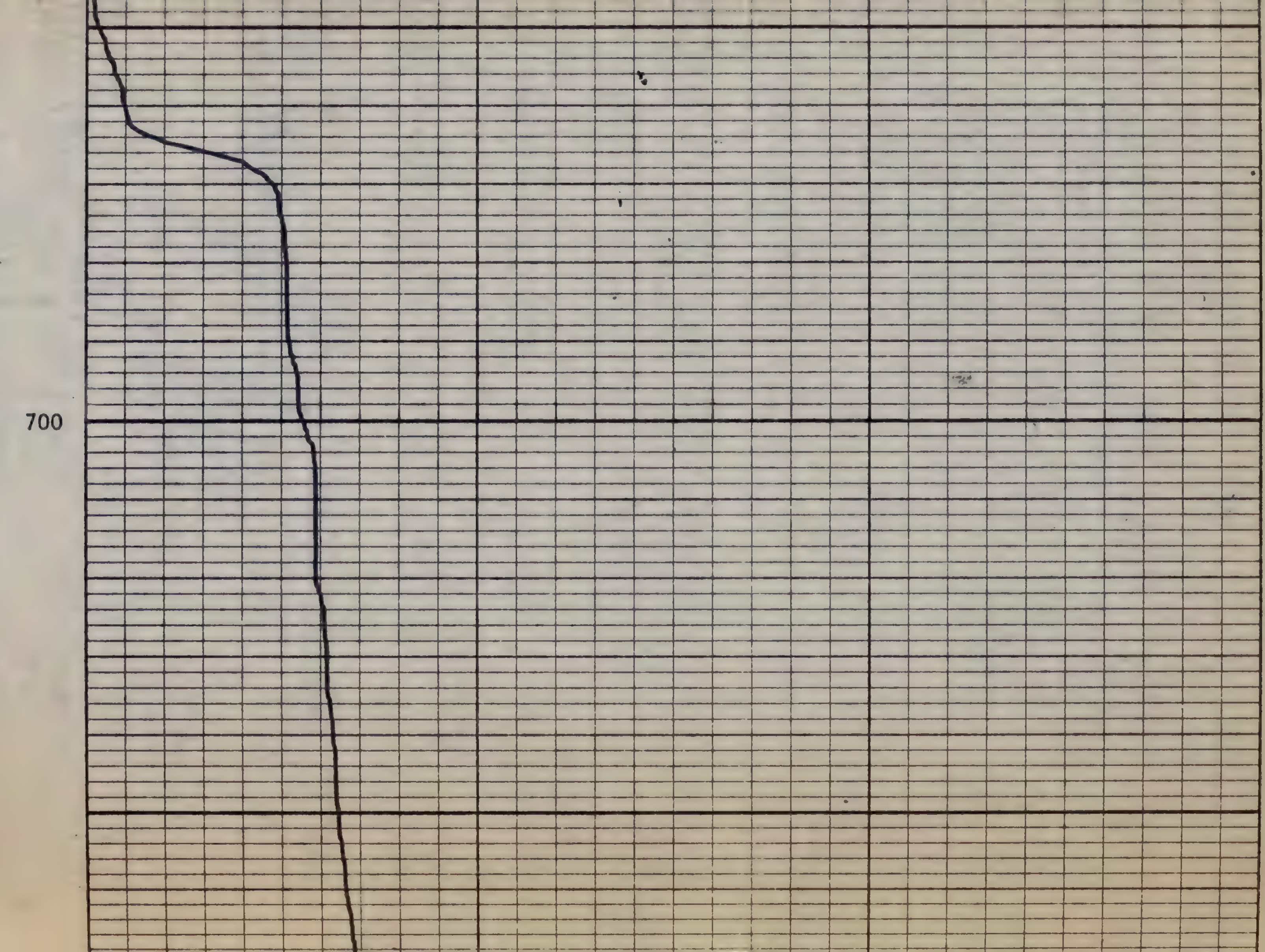
1300
1400
1500
1600
60
61
62
63
64
65
66
67
68
69
70
71
72
73
74
75
75
76
77
78
79
80

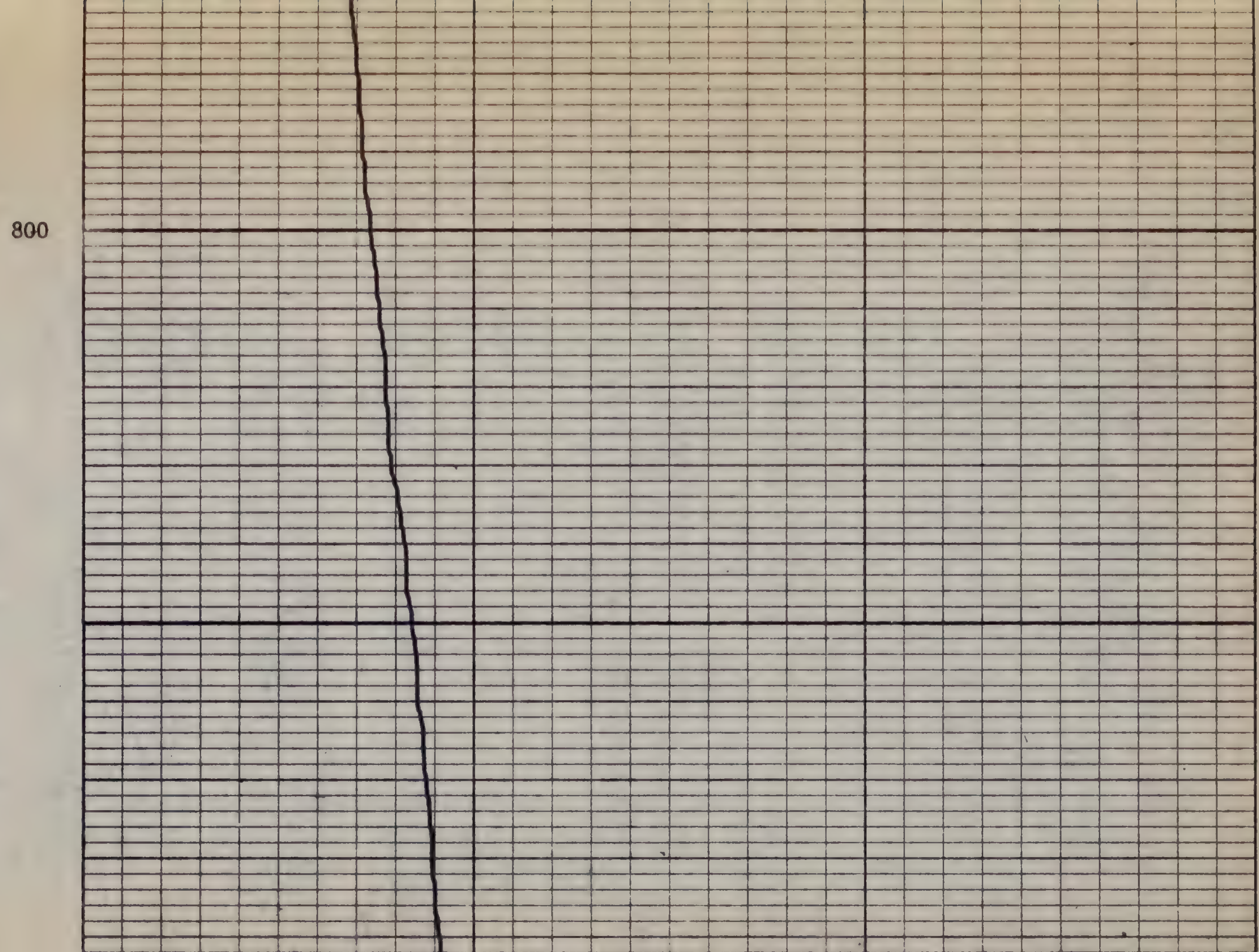
T.D.
1620'




430
50
51
52
500


600
53
54
55
56
57
58
59
60


700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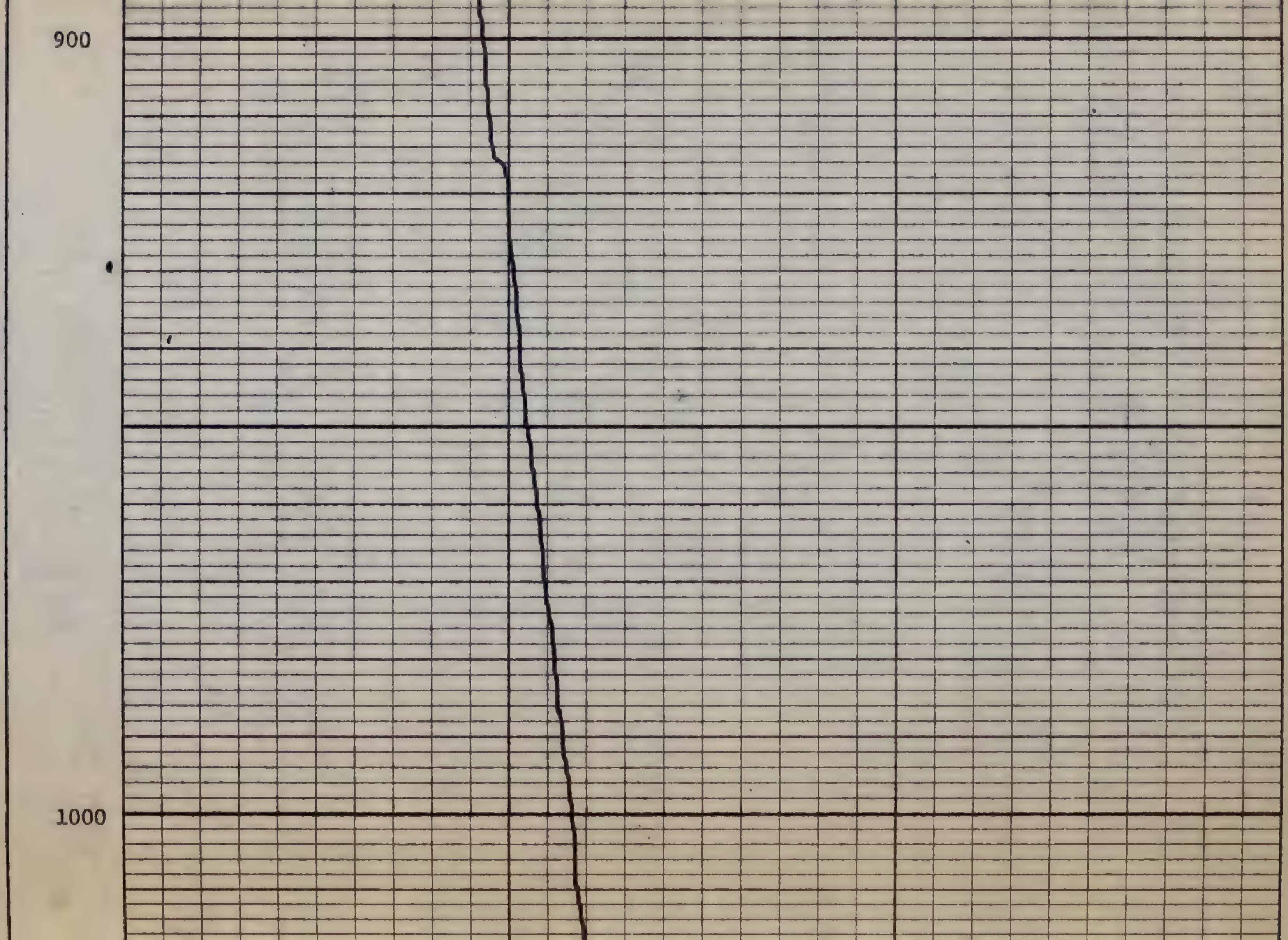
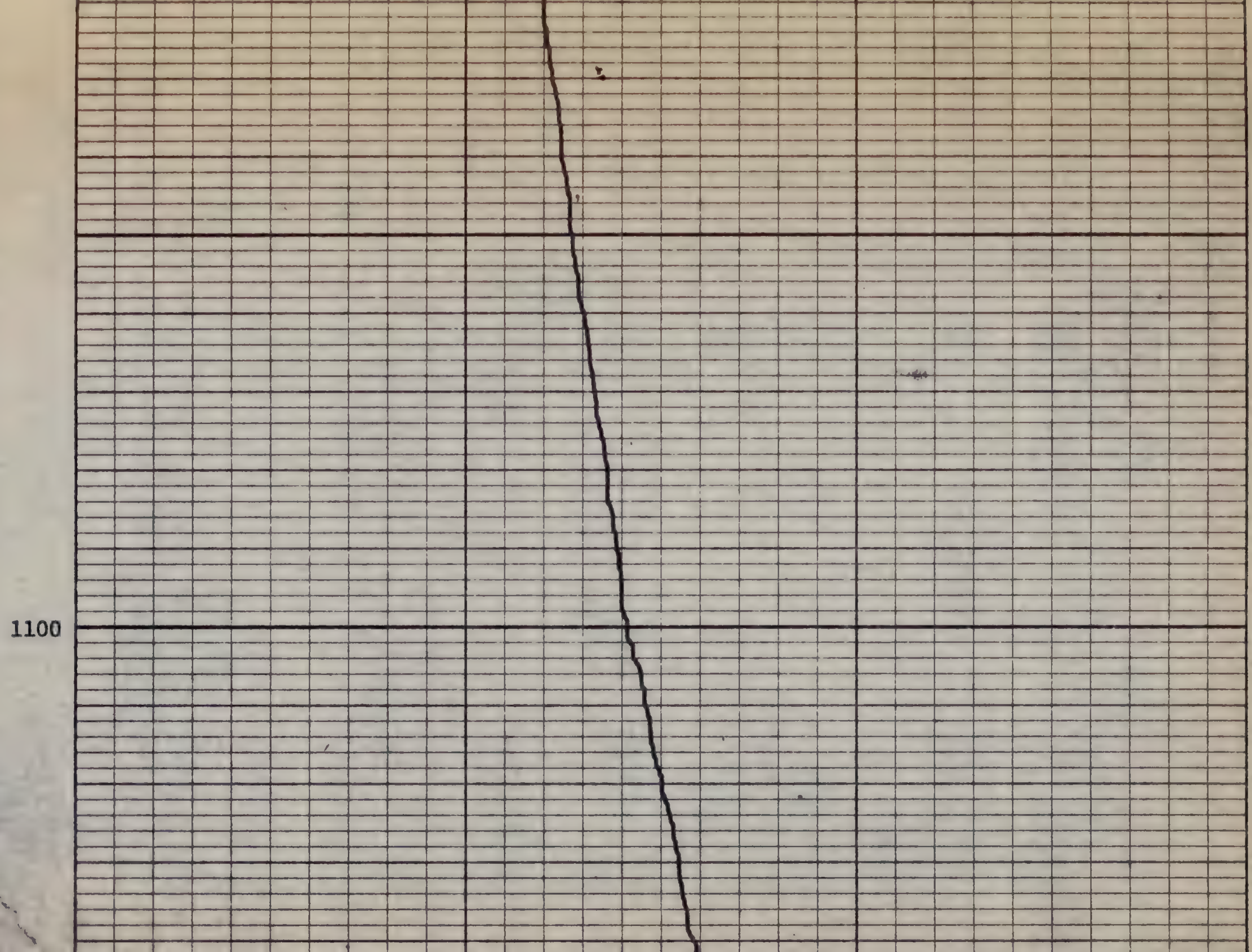
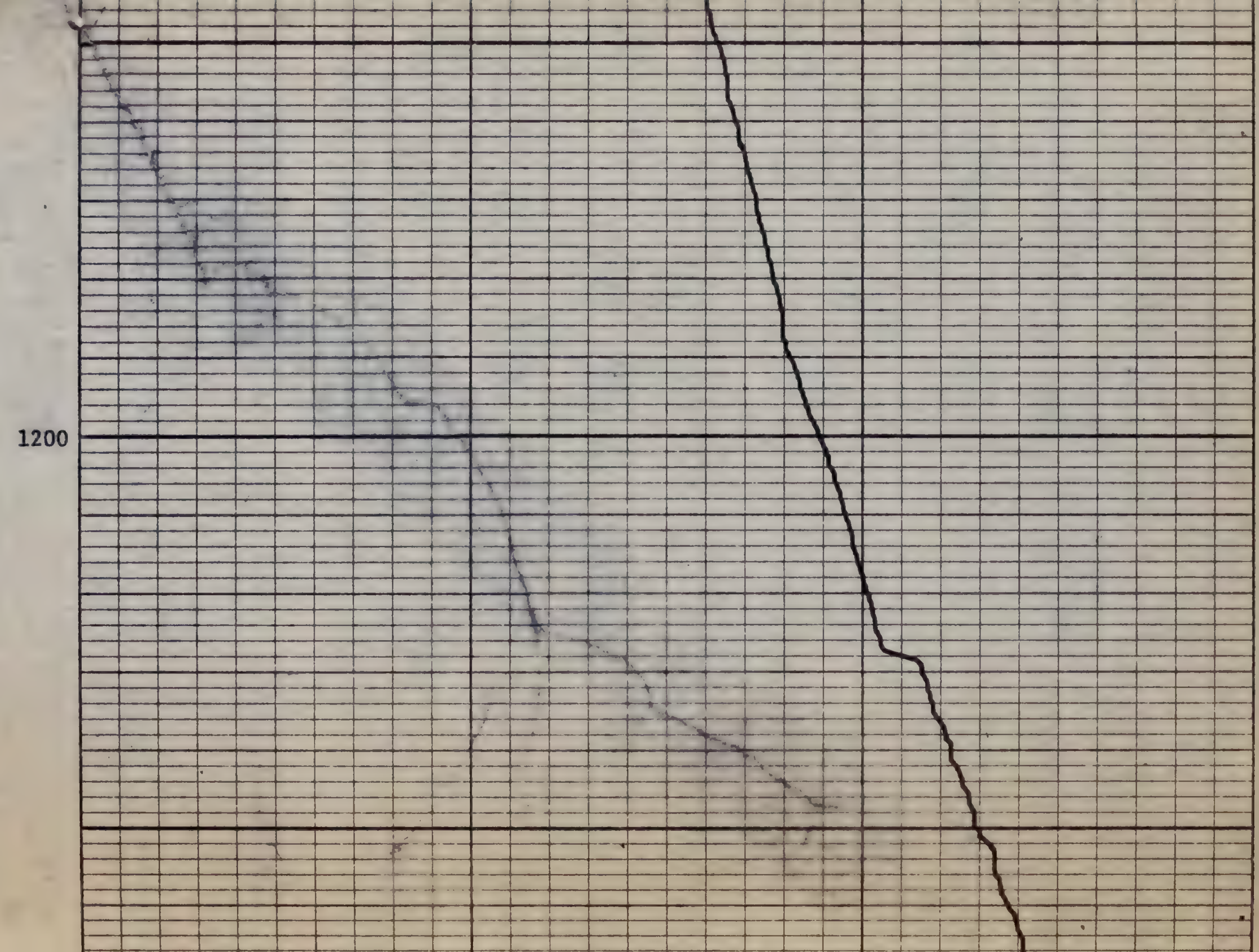
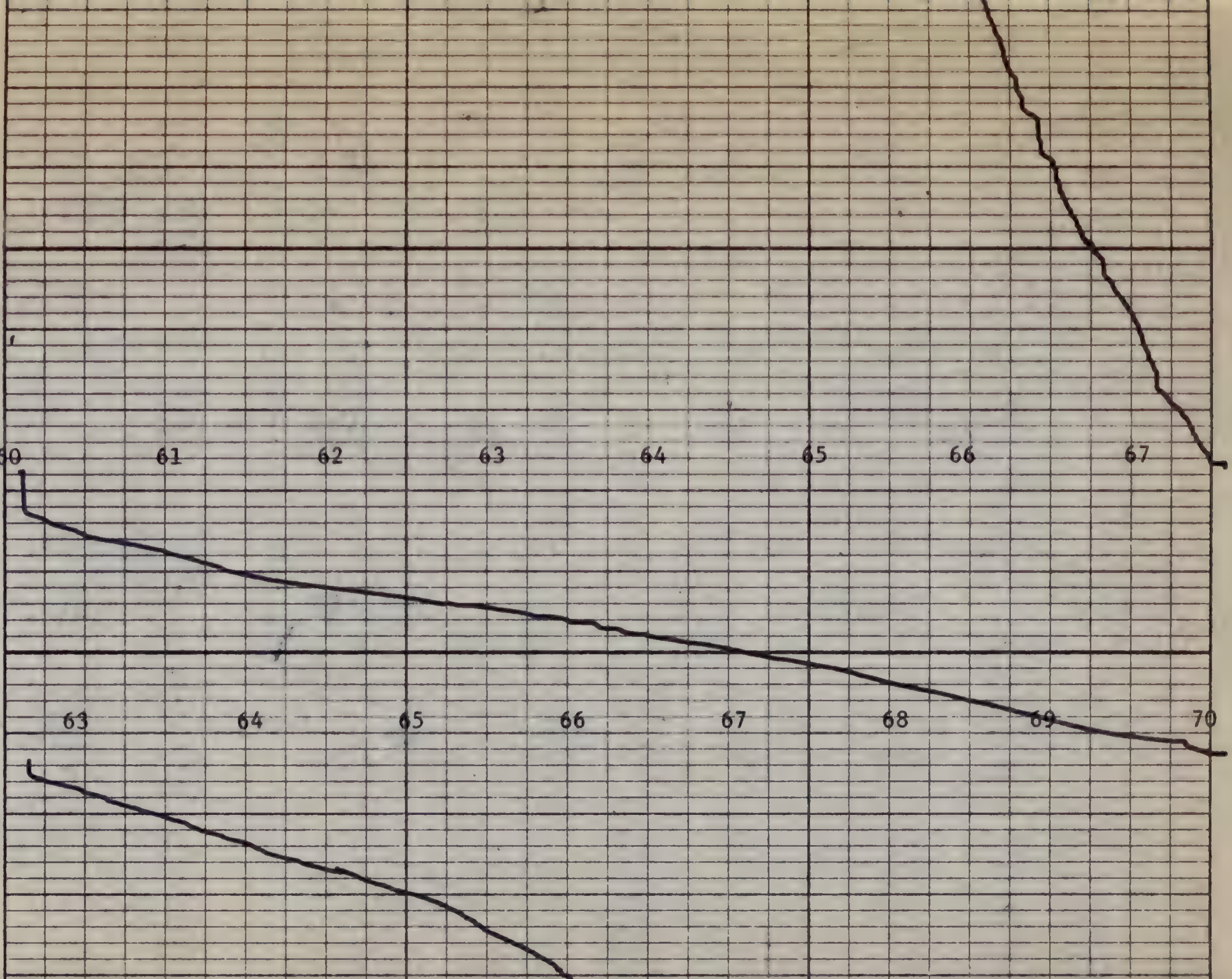

900
1000

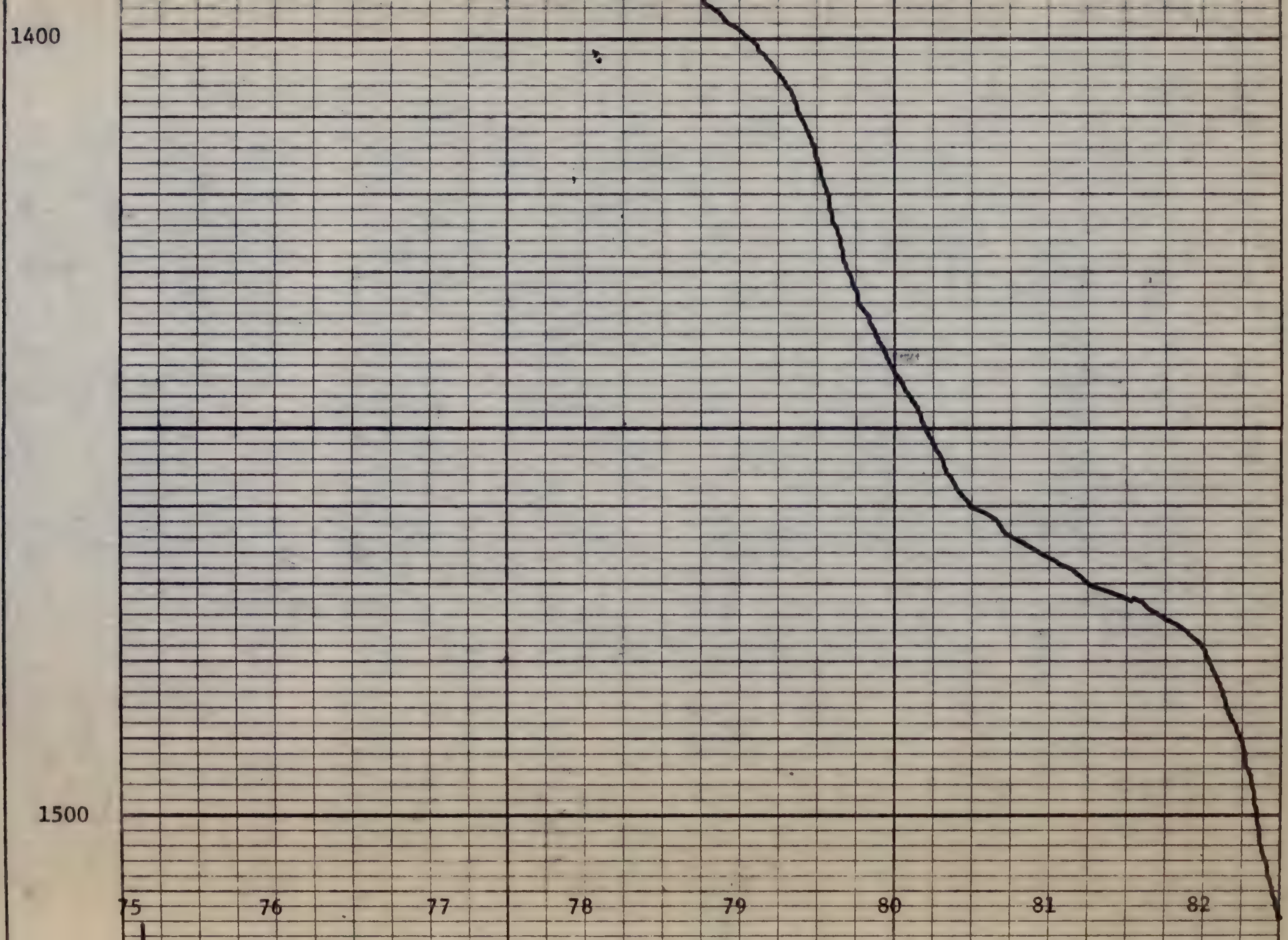

1100

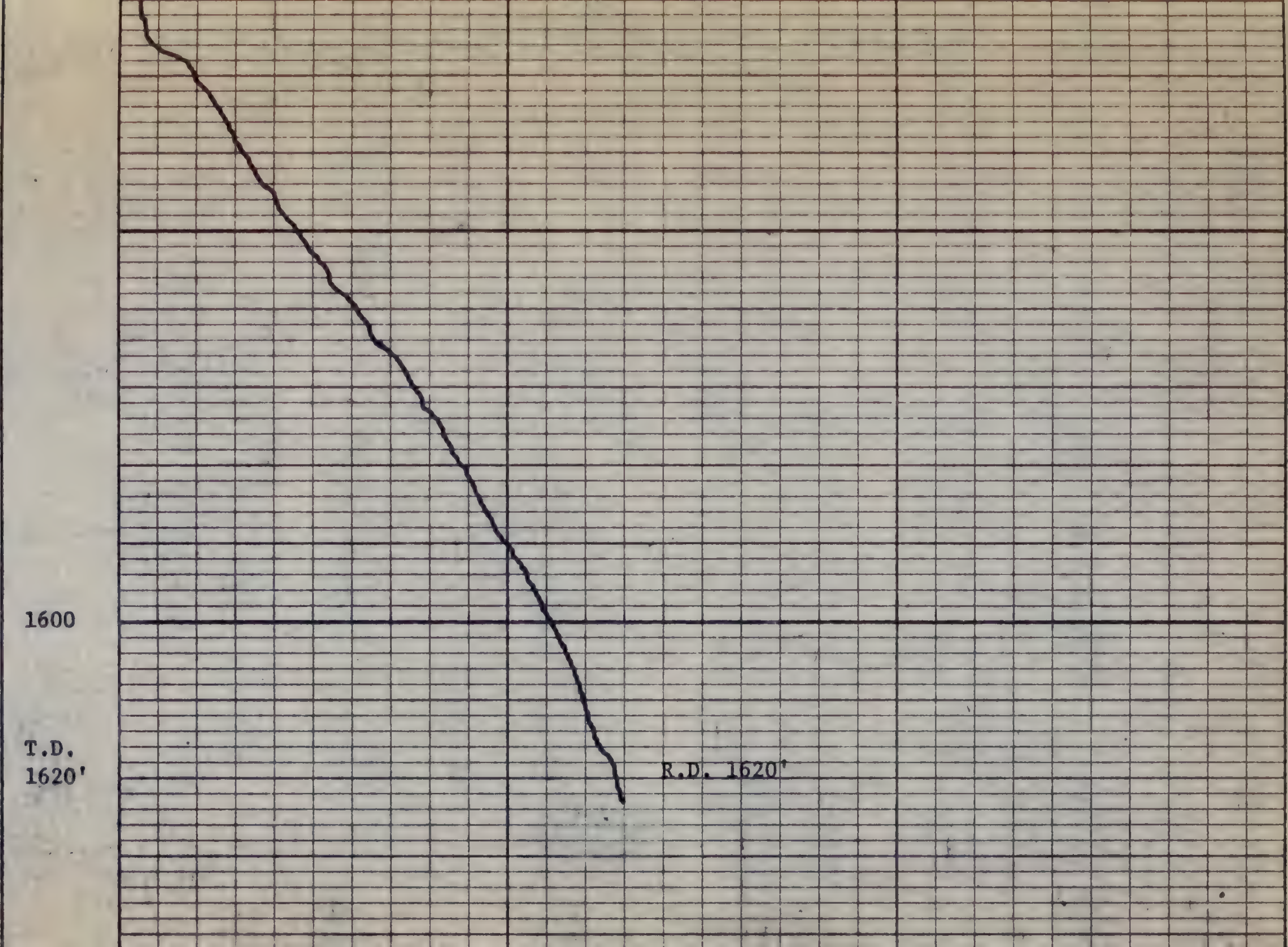


1200

1300




1400
1500
75
76
77
78
79
80
81
82


1600
T.D. 1620'
R.D. 1620'

Schlumberger

DUAL INDUCTION-LATEROLOG
WITH LINEAR CORRELATION LOG

COUNTY RIO BLANCO
FIELD or LOCATION ----
WELL AQUIFER TEST NO. 1-B
COMPANY ATLANTIC RICHFIELD

COMPANY THE ATLANTIC RICHFIELD COMPANY

WELL AQUIFER TEST NO. 1-B

FIELD -----

COUNTY RIO BLANCO STATE COLORADO

Location. API Serial No. 01036

Sec. 7 Twp. 3S Rge. 96W

Other Services:
FDC-GR ENG.
CNL-GR PRO.
BHC-GR

Permanent Datum: GL ; Elev.: 6909
Log Measured From GL , 0 Ft. Above Perm. Datum
Drilling Measured From GL

Elev.: K.B. ----
D.F. ----
G.L. 6909

Date	7-21-74			
Run No.	ONE			
Depth—Driller	1638			
Depth—Logger	1640			
Btm. Log Interval	1636			
Top Log Interval	75			
Casing—Driller	8-5/8@ 60	@	@	@
Casing—Logger	72			
Bit Size	7-7/8			
Type Fluid in Hole	WATER			
Fluid Level	410			
Dens. | Visc.	8.3 | --	|	|	|
pH | Fluid Loss	--- | -- ml	| ml	| ml	| ml
Source of Sample				
R_m @ Meas. Temp.	@ °F	@ °F	@ °F	@ °F
R_{mf} @ Meas. Temp.	@ °F	@ °F	@ °F	@ °F
R_{mc} @ Meas. Temp.	@ °F	@ °F	@ °F	@ °F
Source: R_{mf} | R_{mc}	|	|	|	|
R_m @ BHT	@ °F	@ °F	@ °F	@ °F
Time Since Circ.	14 HRS.			
Max. Rec. Temp.	90 °F	°F	°F	°F
Equip. | Location	5602 | G.J.	|	|	|
Recorded By	SCHNORR			
Witnessed By	TAIT			

SWS-1608-F

CHANGES IN MUD TYPE OR ADDITIONAL SAMPLES

Date / Sample No.				
Depth - Driller				
Type Fluid in Hole				
Dens. / Visc.				
ph / Fluid Loss		ml		ml
Source of Sample				
R_m @ Meas. Temp.	@	°F	@	°F
R_{mf} @ Meas. Temp.	@	°F	@	°F
R_{mc} @ Meas. Temp.	@	°F	@	°F
Source: R_{mf} / R_{mc}				
R_m @ BHT	@	°F	@	°F
R_{mf} @ BHT	@	°F	@	°F
R_{mc} @ BHT	@	°F	@	°F

SCALE CHANGES

Type Log	Depth	Scale Up Hole	Scale Down Hole

EQUIPMENT DATA

Run Na.	ONE			
Panel No.	CB-180			
Cart. No.	B-163			
Sonde No.	DB-49			
Mem. Panel No.	B-260			
G.R. Cart No.	----			
G.R. Panel No.	----			
TTR No.	---			
Cent. Device	RUBBER			
Stand off - Inches	1-1/2"			
Time Const. - Sec.	----			
Speed - F.P.M.	----			

REMARKS

Service Order No. - SO #01036

☒ Surface determined sonde errors used for 6FF40.

☐ 6FF40 sonde error corrected for inch borehole signal at R_m =

☐ 6FF40 zero set in hole at depth of feet.

CALIBRATION DATA

CALIBRATION:	BACKGND. CPS.	SOURCE CPS.	GALV. INCR. DIVISION	SENS. TAP (FOR CAL.)	SENS. TAP (RECORD)	TIME CONST.
GAMMA RAY:						

CALIBRATION:	BACKGND. CPS.	SOURCE CPS.	GALV. INCR. DIVISION	SENS. TAP (FOR CAL.)	SENS. TAP (RECORD)	TIME CONST.	
GAMMA RAY:							

All interpretations are opinions based on inferences from electrical or other measurements and we cannot, and do not guarantee the accuracy or correctness of any interpretations, and we shall not, except in the case of gross or willful negligence on our part, be liable or responsible for any loss, costs, damages or expenses incurred or sustained by anyone resulting from any interpretation made by any of our officers, agents or employees. These interpretations are also subject to Clause 7 of our General Terms and Conditions as set out in our current Price Schedule.

SPONTANEOUS-POTENTIAL
MILLIVOLTS

− |20 MV| +

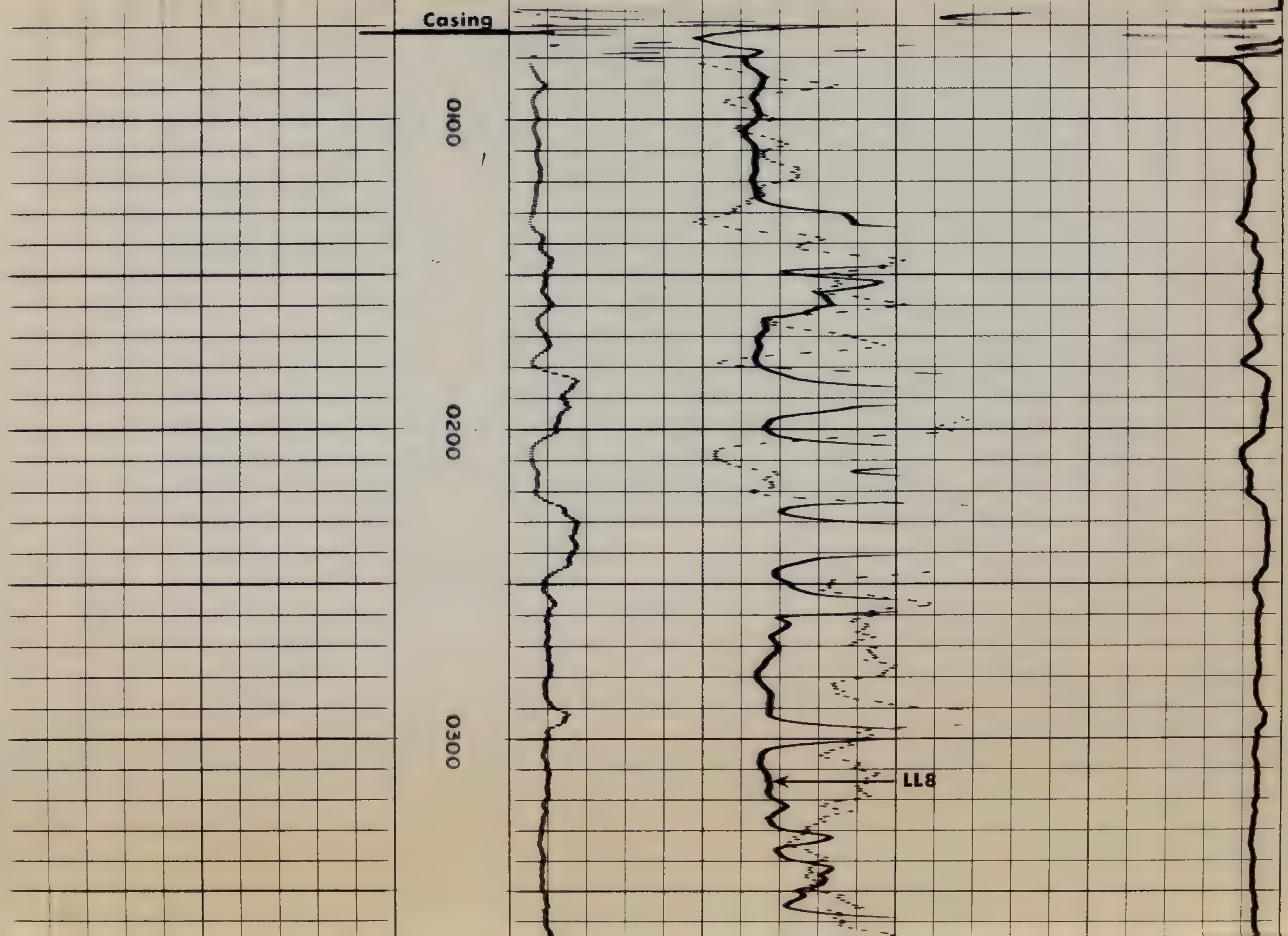
CONDUCTIVITY
MILLIMHOS/M = $\frac{1000}{\text{OHMS. } M^2/M}$

DEEP INDUCTION LOG
400 200 0

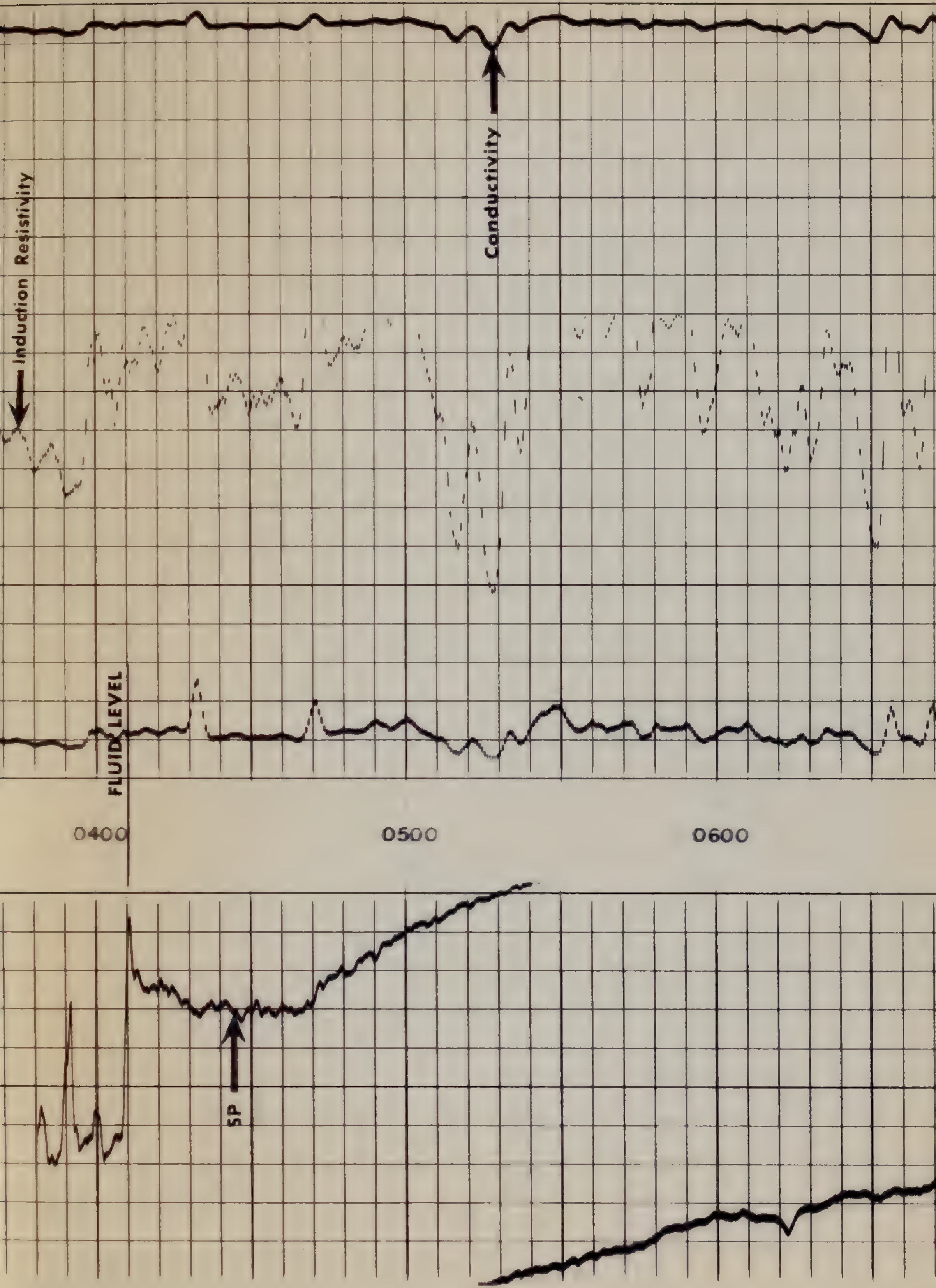
RESISTIVITY
OHMS. M^2/M

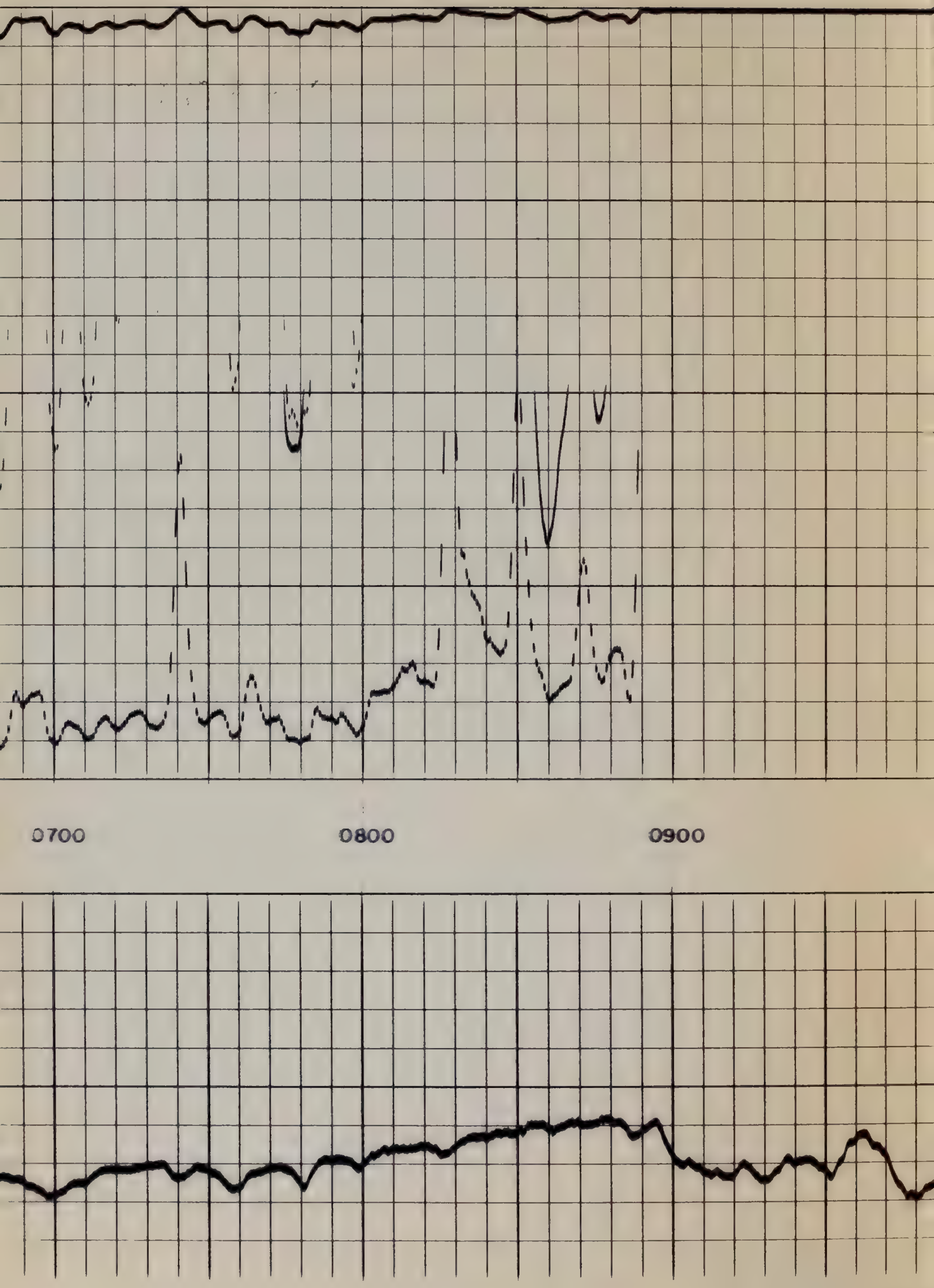
DEEP INDUCTION LOG
0 100
0 1000

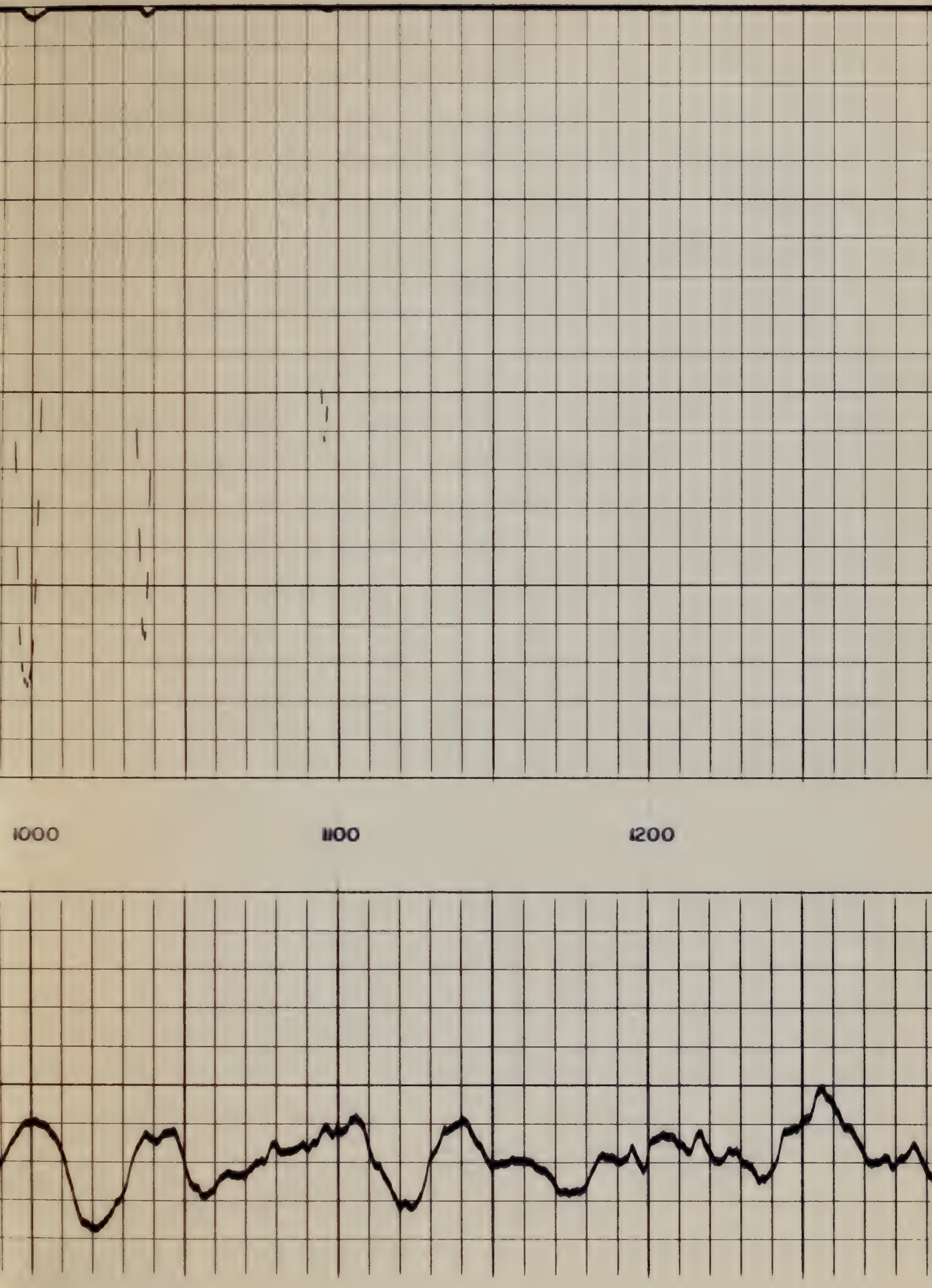
AVERAGED LATEROLOG - 8
0 100
0 1000

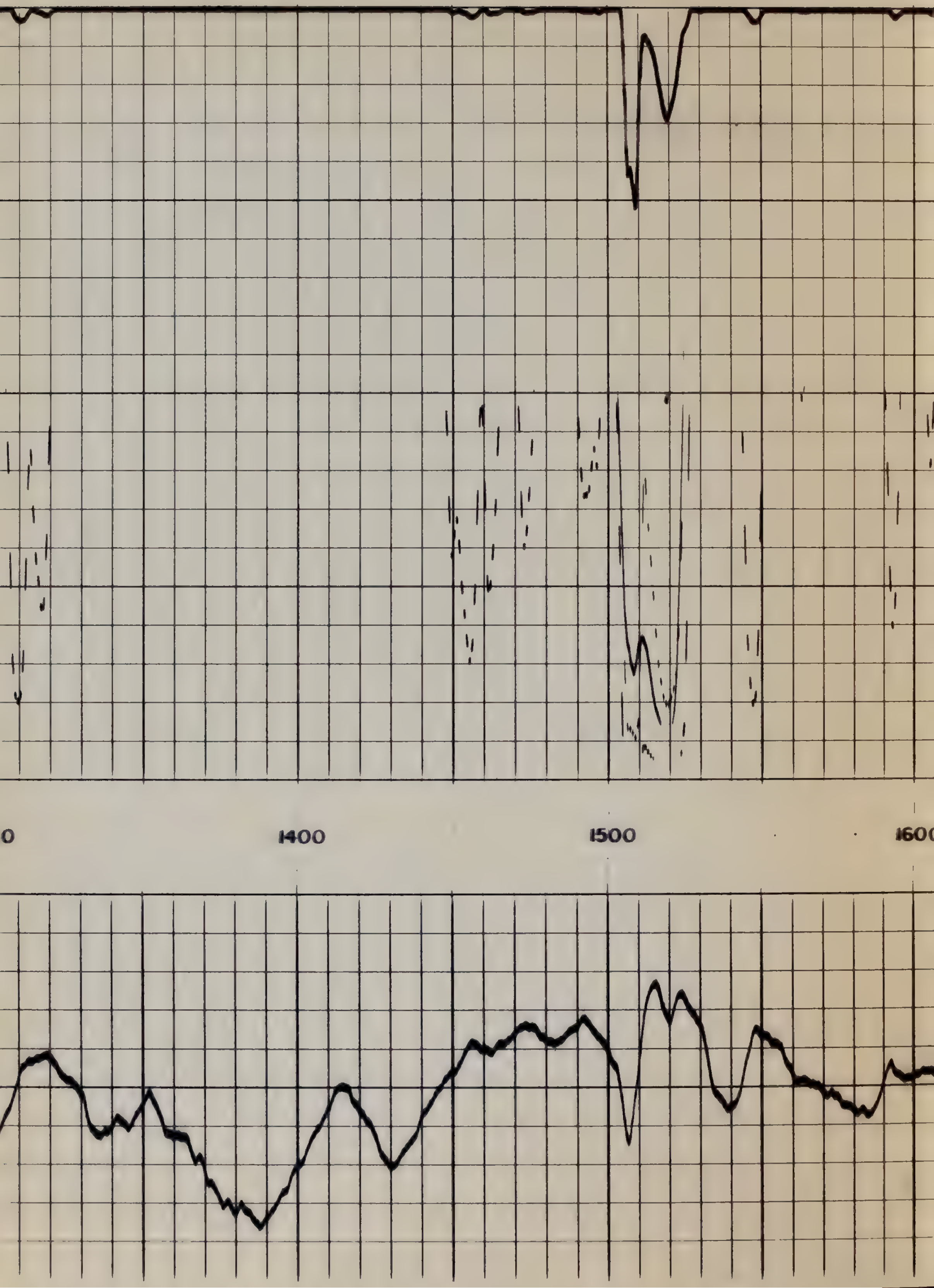


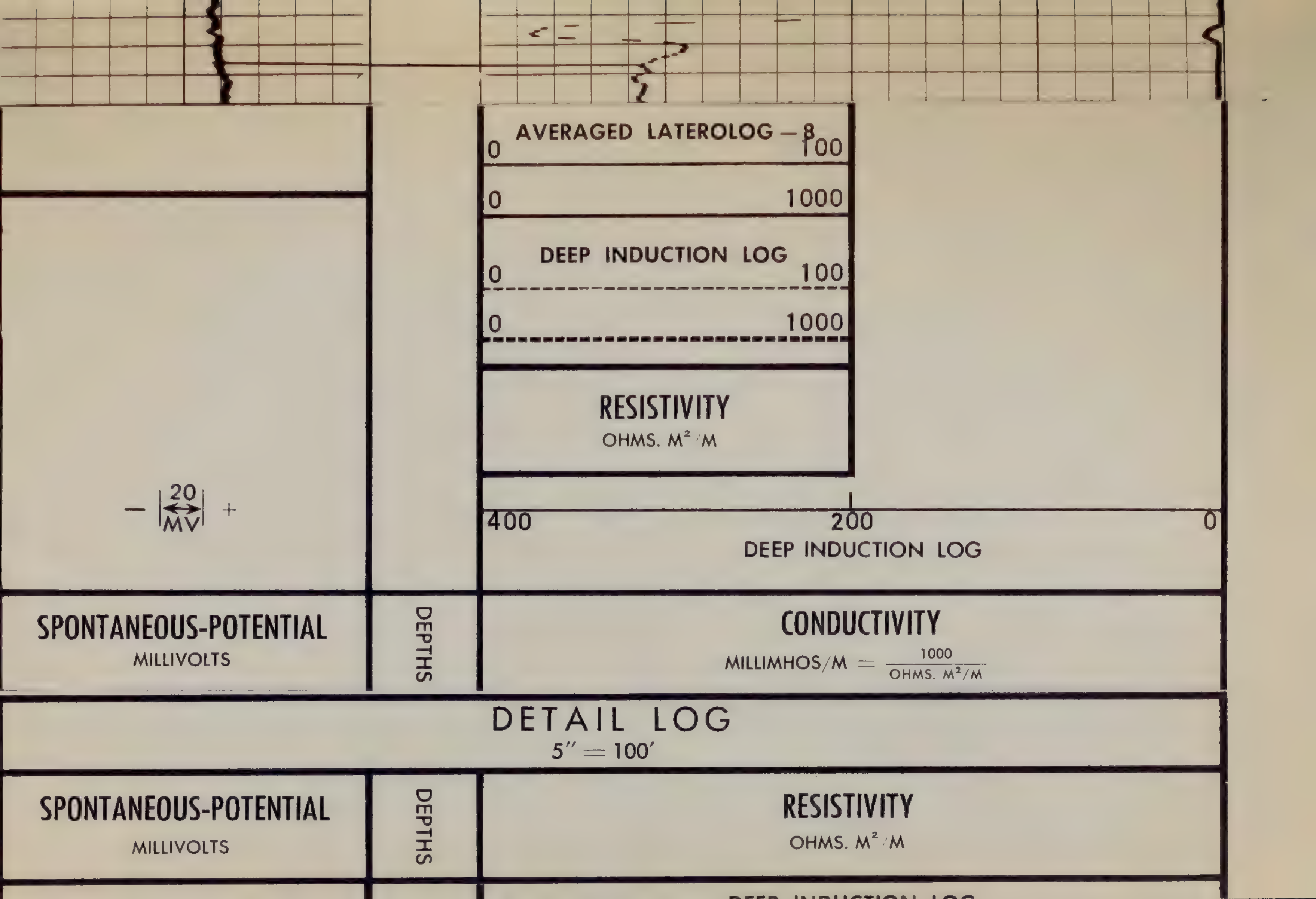
Casing
0100
0200
0300
LL8

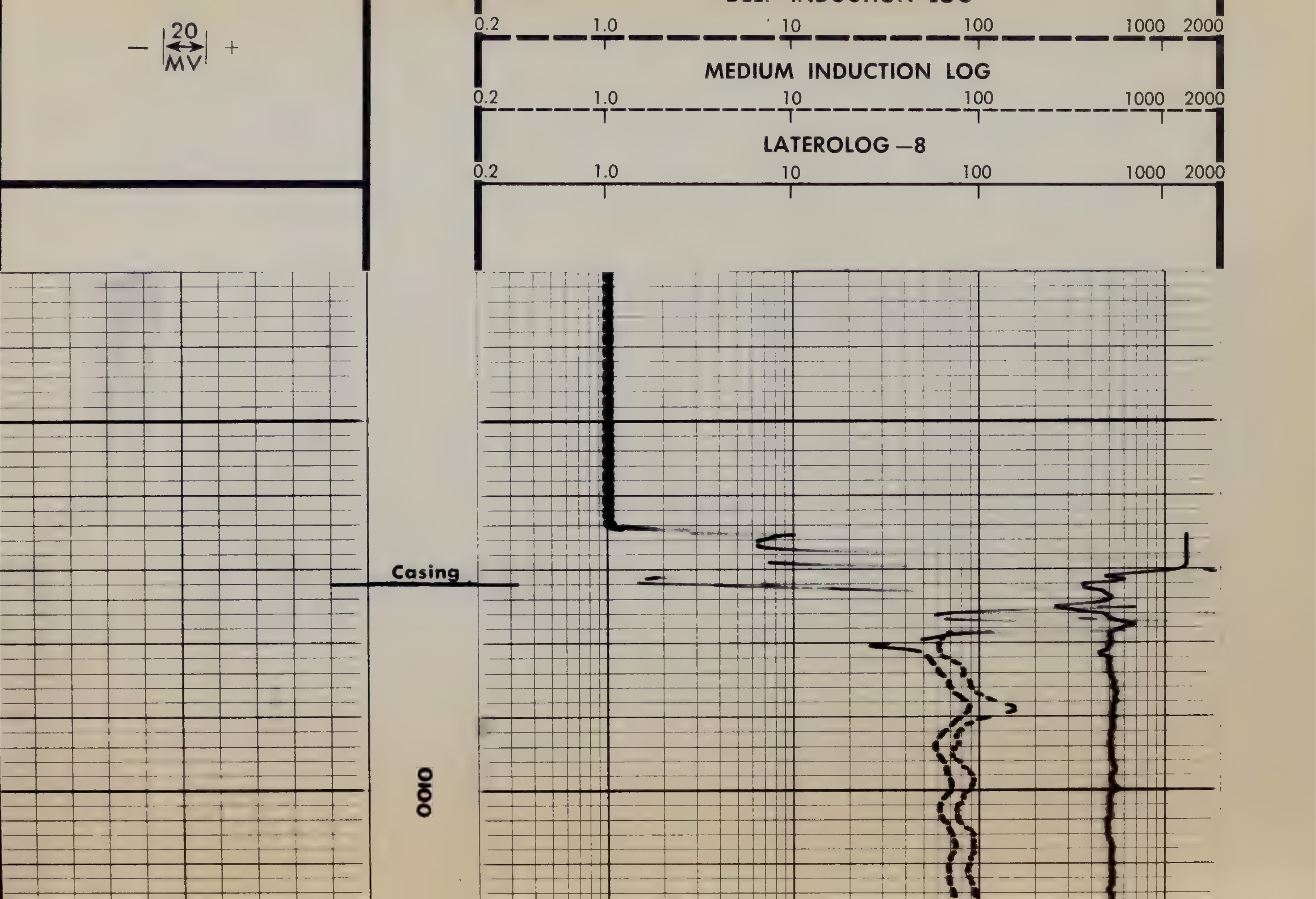

Induction Resistivity
Conductivity
FLUID LEVEL
0400
0500
0600
SP


0700
0800
0900

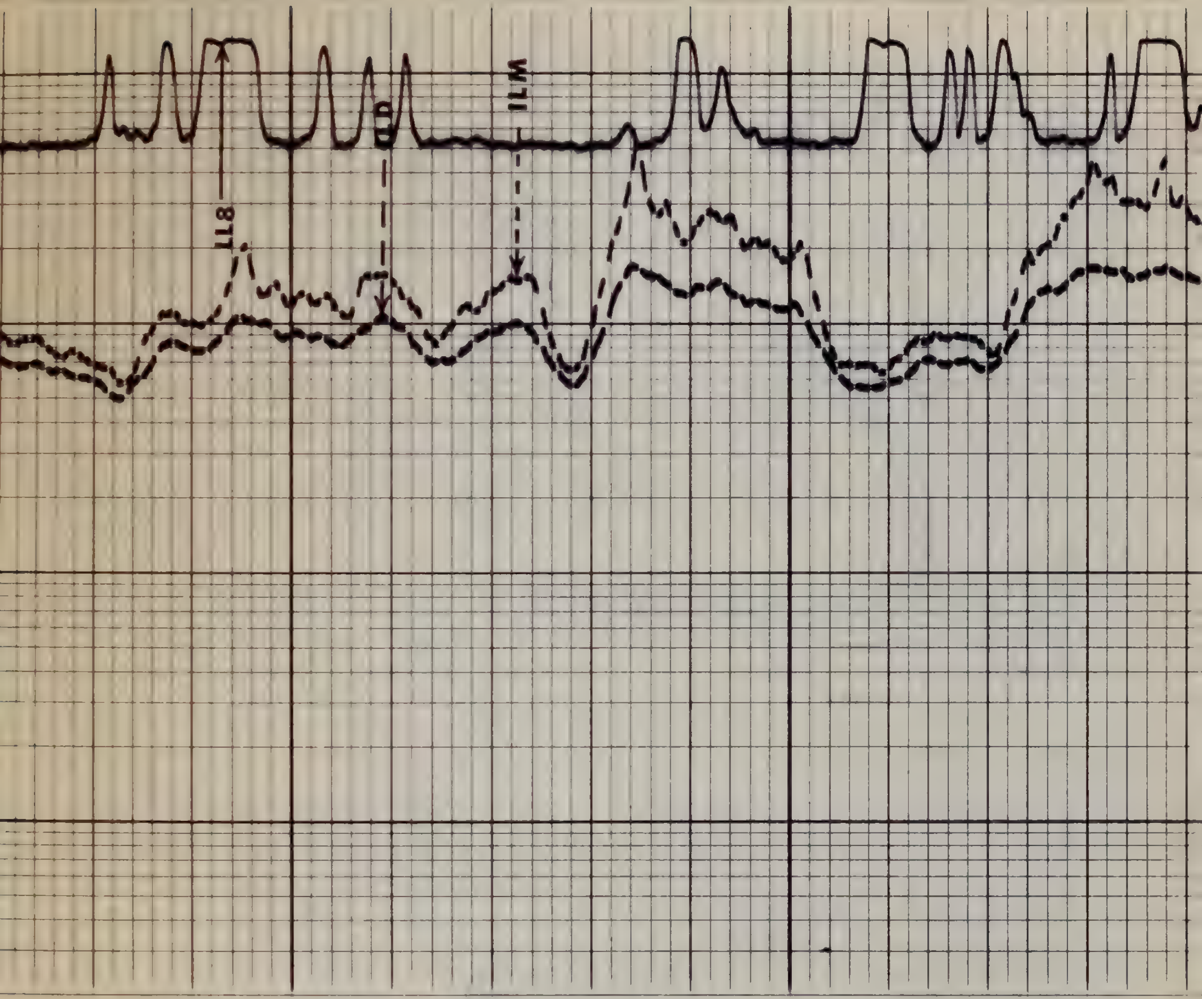

1000
1100
1200


1400
1500
1600

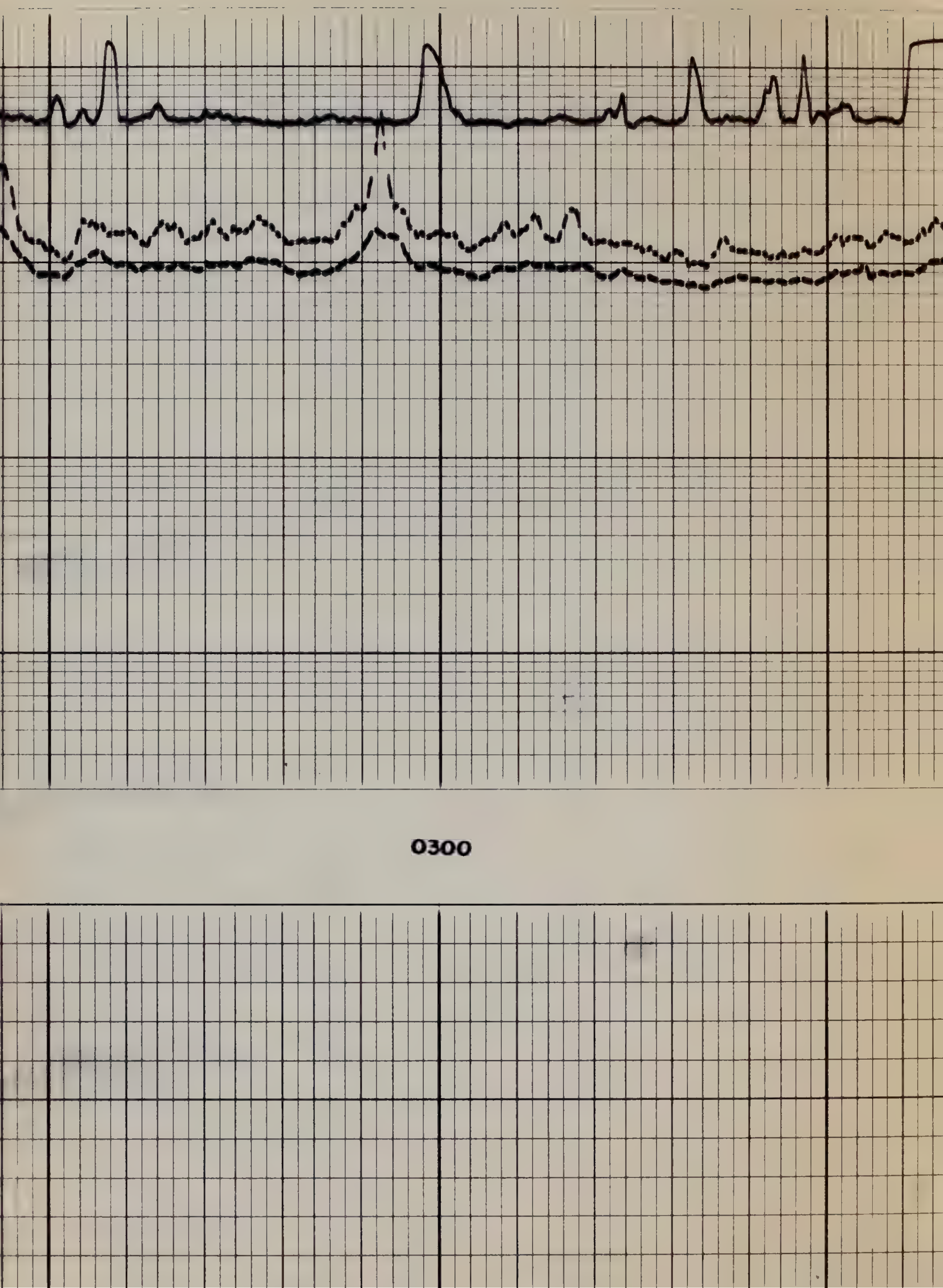

AVERAGED LATEROLOG — 8
0
100
0
1000
DEEP INDUCTION LOG
0
100
0
1000
RESISTIVITY
OHMS. M² /M
— 20 MV +
400
200
0
DEEP INDUCTION LOG
SPONTANEOUS-POTENTIAL
MILLIVOLTS
DEPTHS
CONDUCTIVITY
MILLIMHOS/M = 1000 / OHMS. M²/M
DETAIL LOG
5″ = 100′
SPONTANEOUS-POTENTIAL
MILLIVOLTS
DEPTHS
RESISTIVITY
OHMS. M² /M

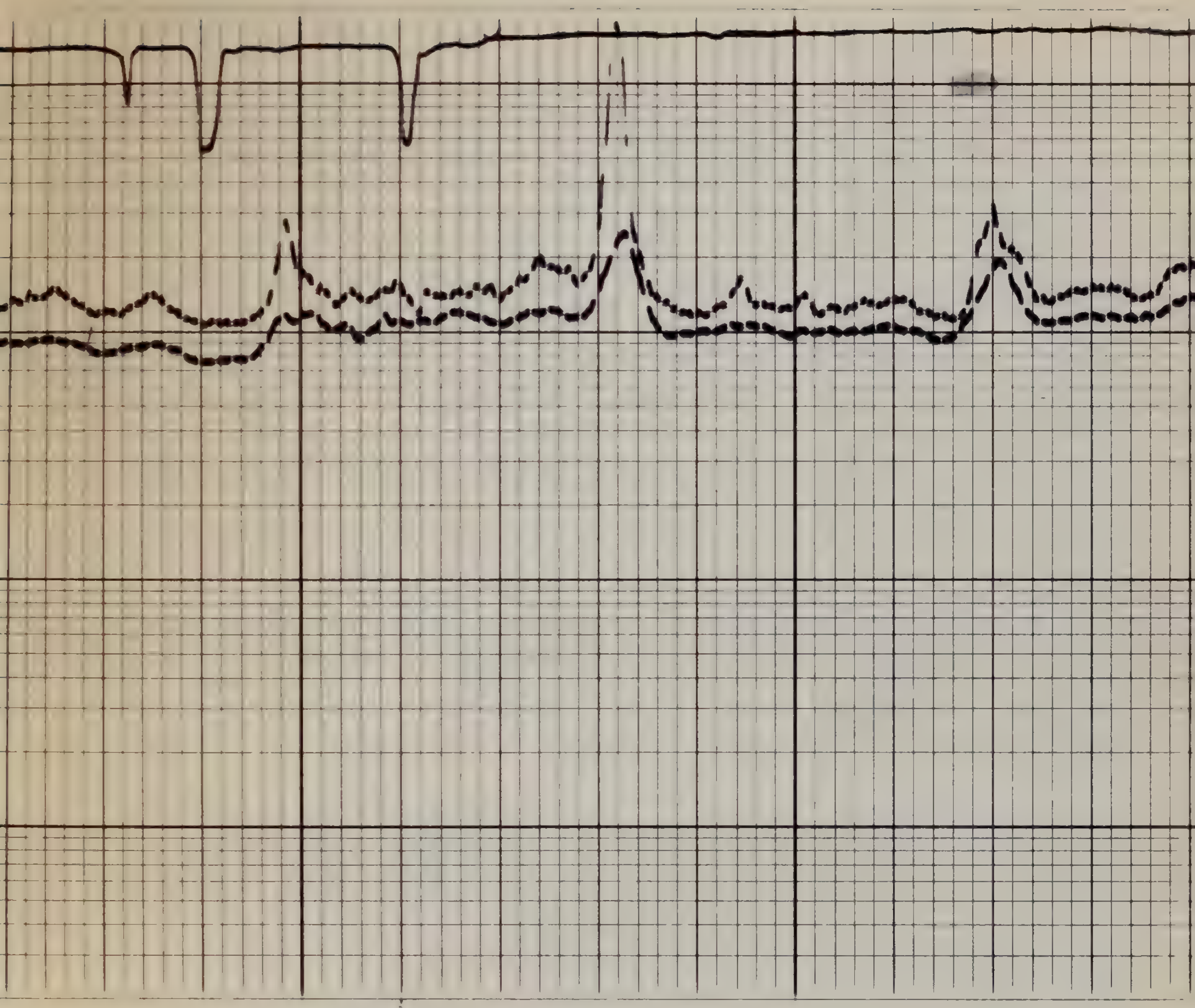


— 20 MV +
0.2
1.0
10
100
1000
2000
MEDIUM INDUCTION LOG
0.2
1.0
10
100
1000
2000
LATEROLOG —8
0.2
1.0
10
100
1000
2000
Casing
0100



0200


0300



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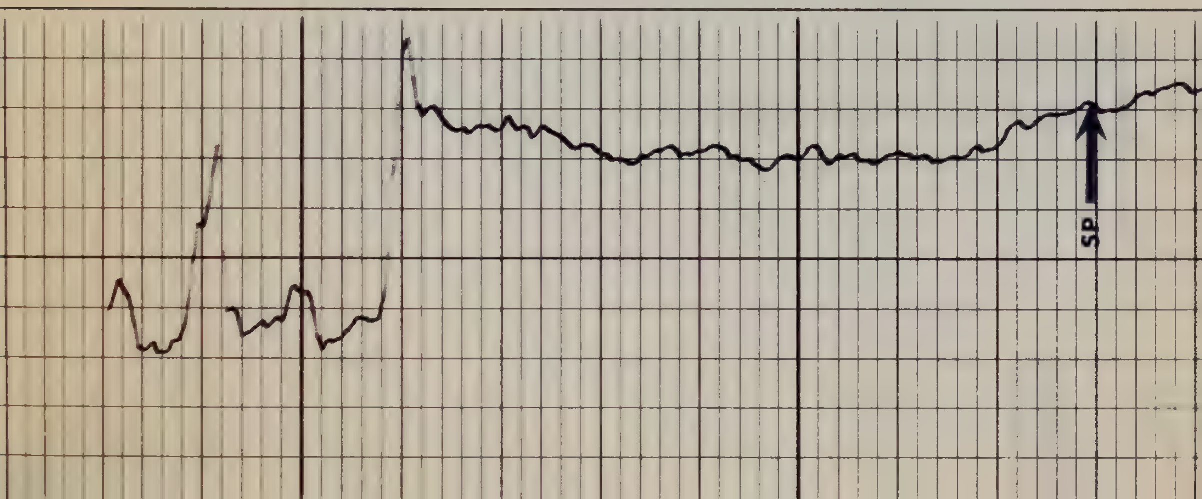
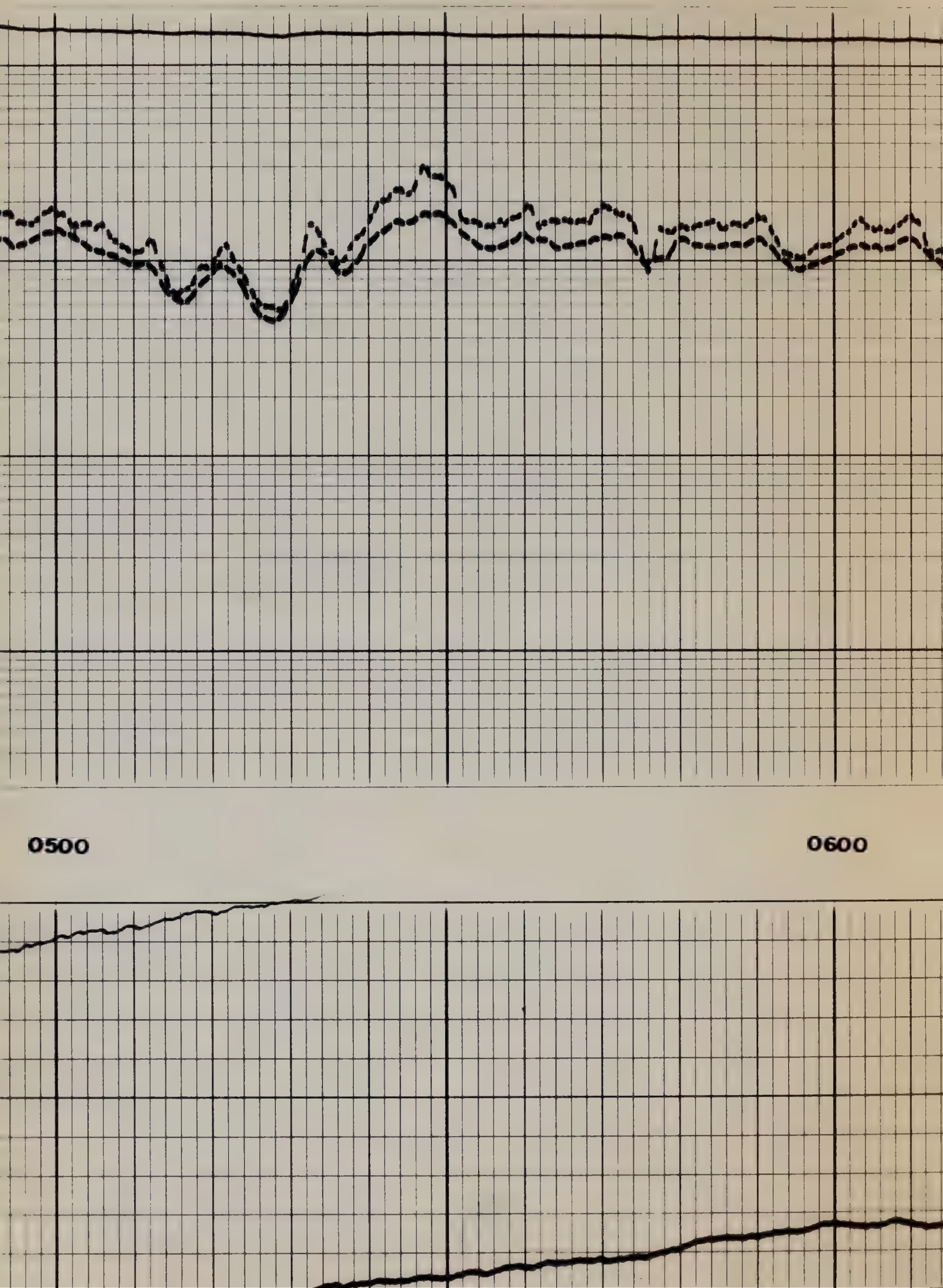
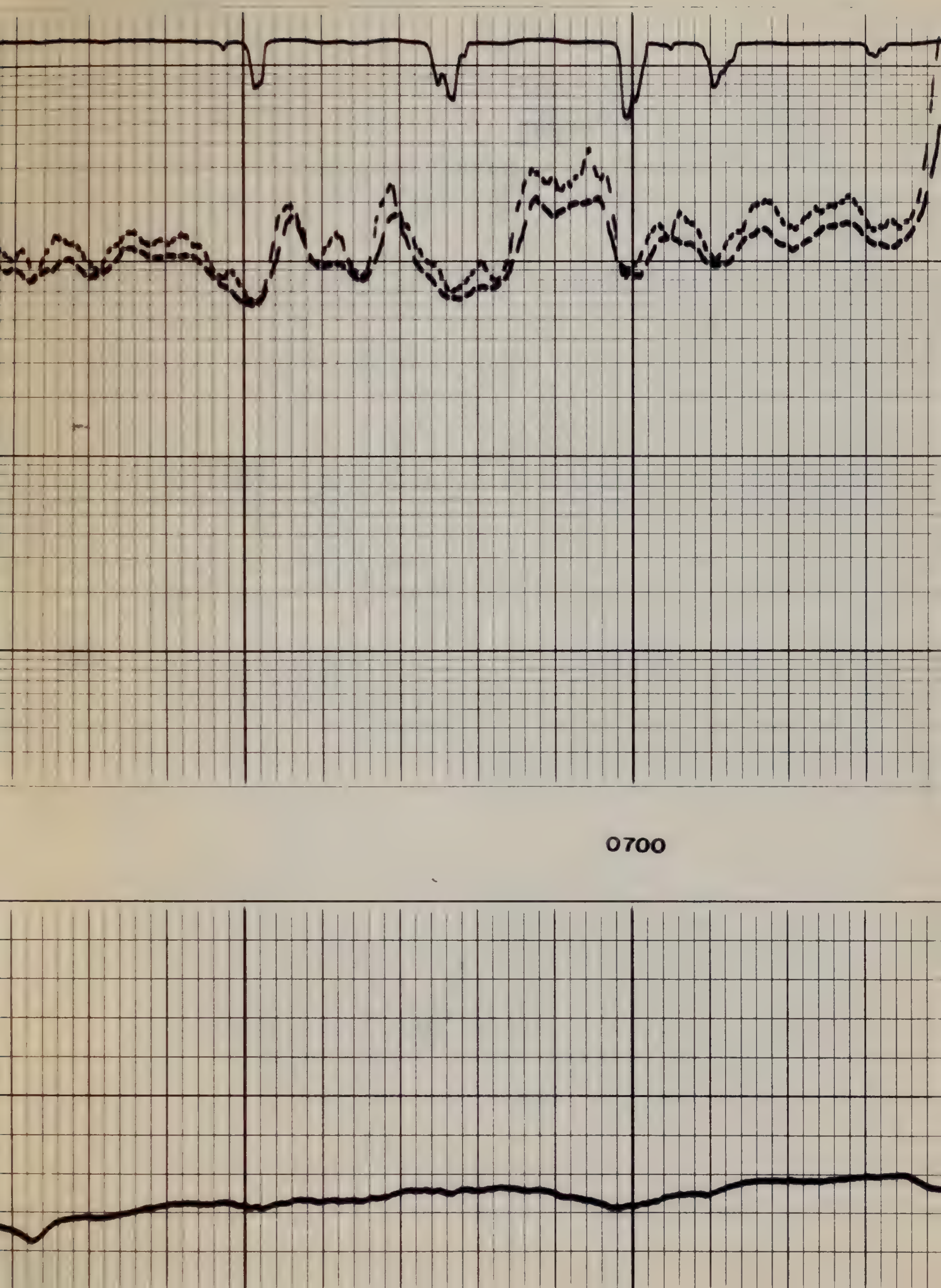



0500
0600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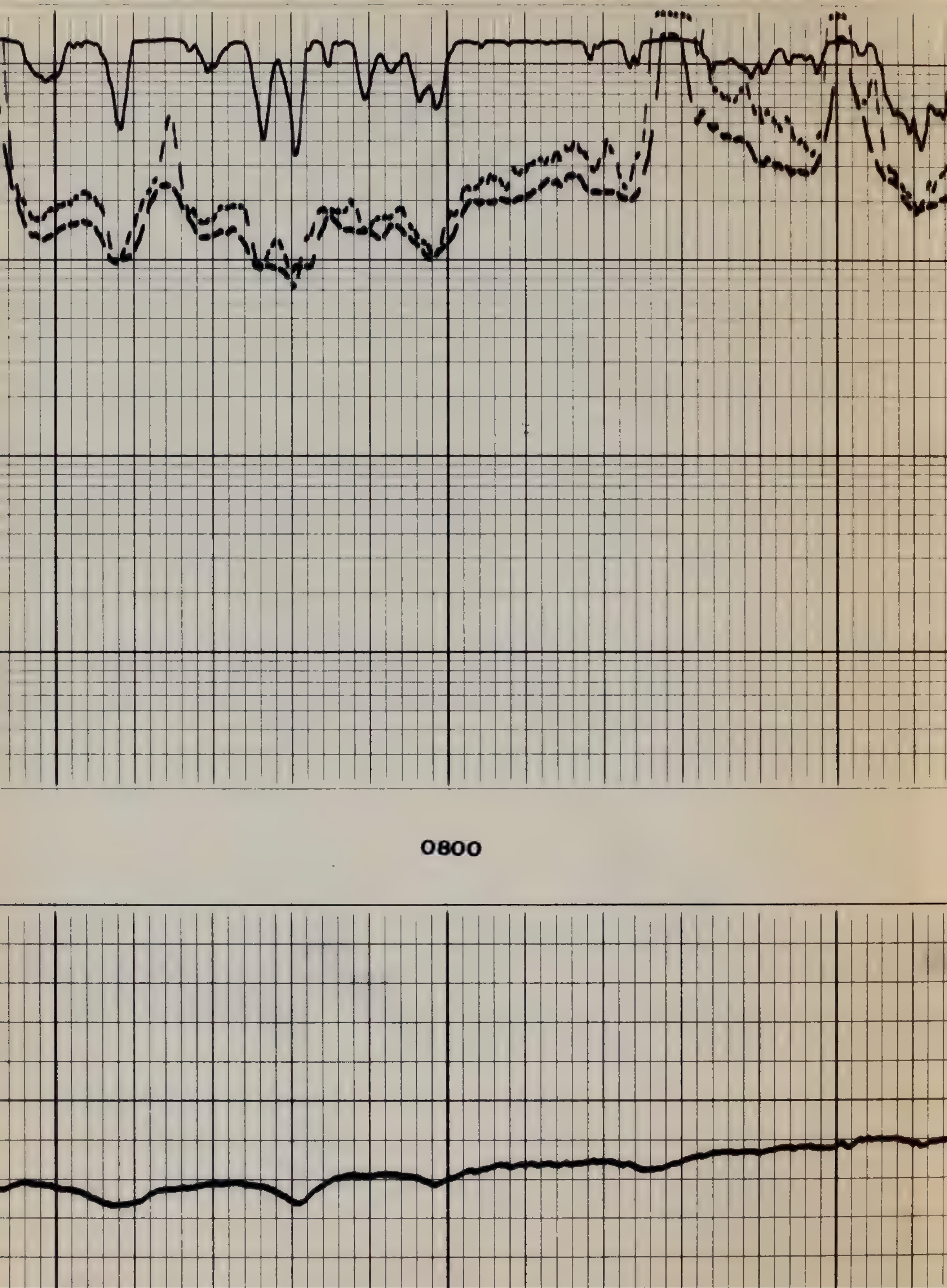
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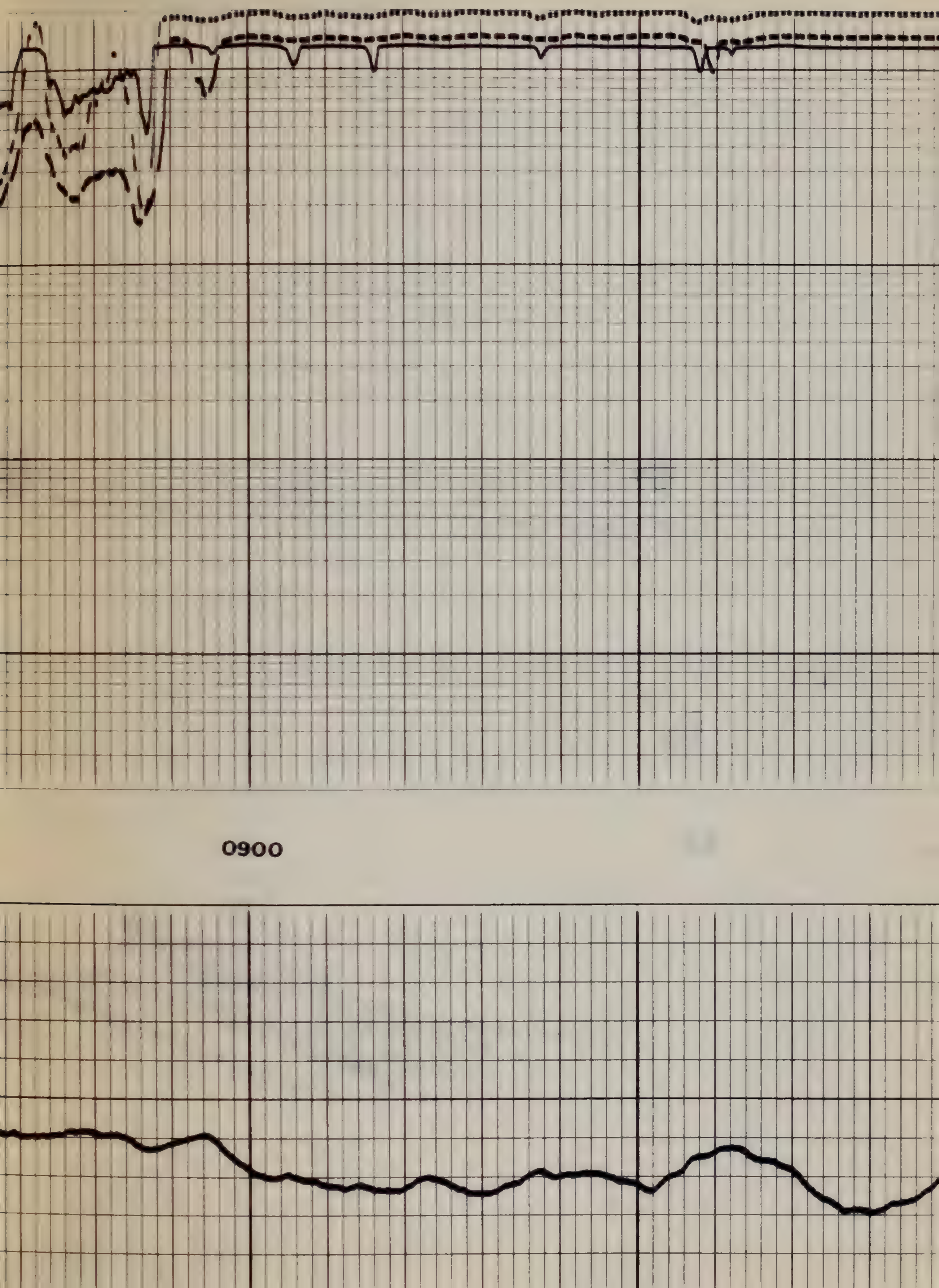
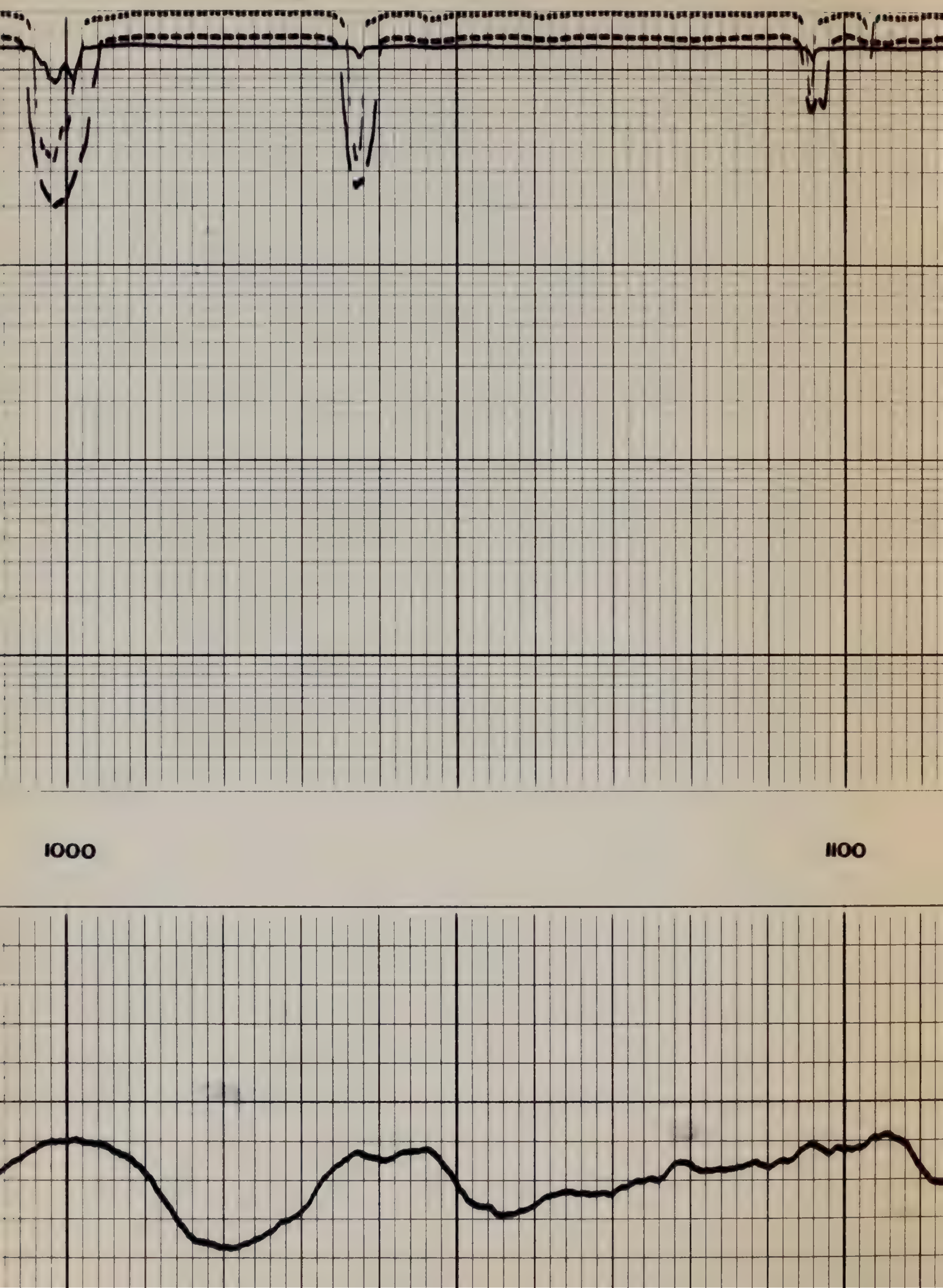
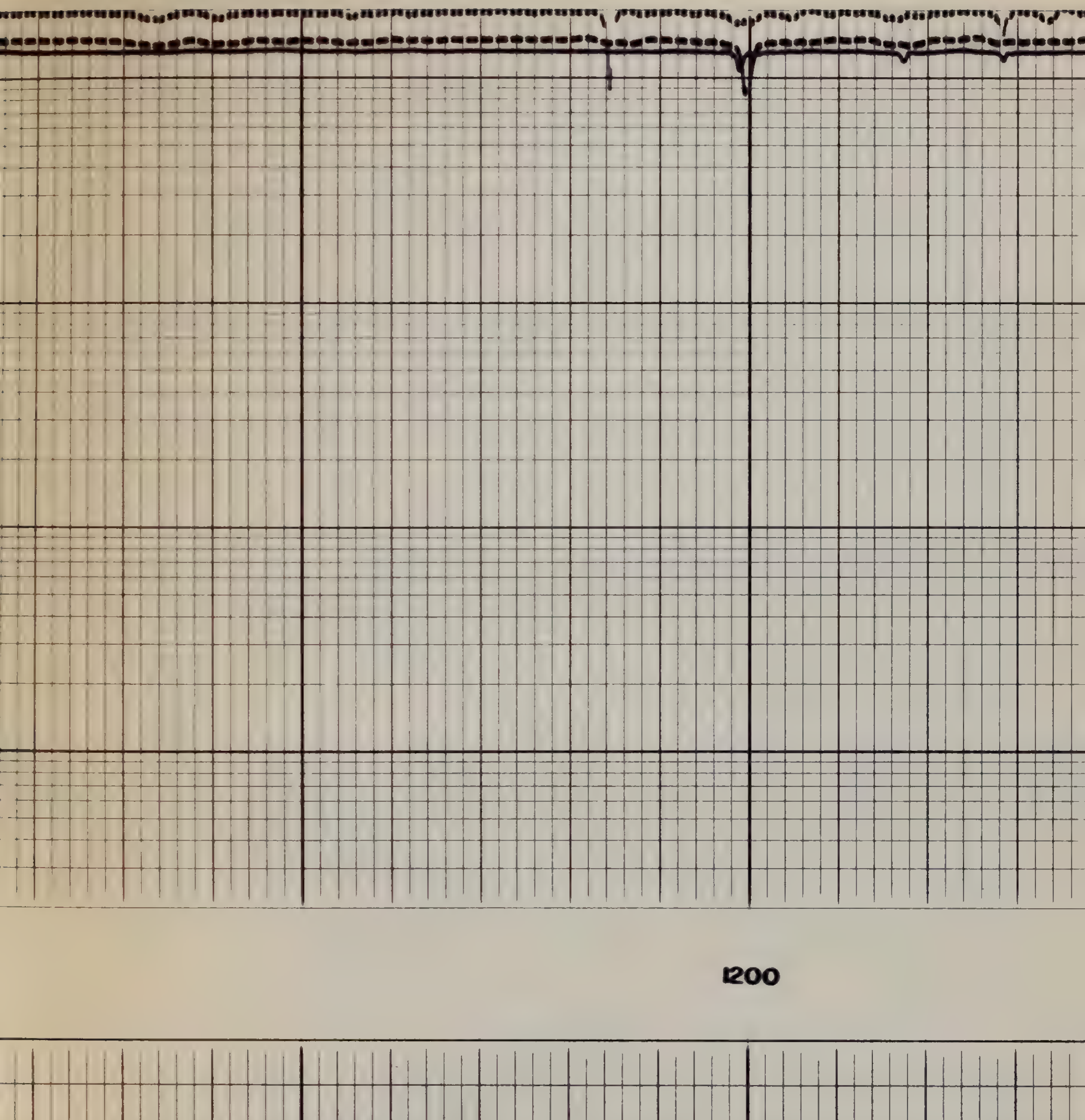
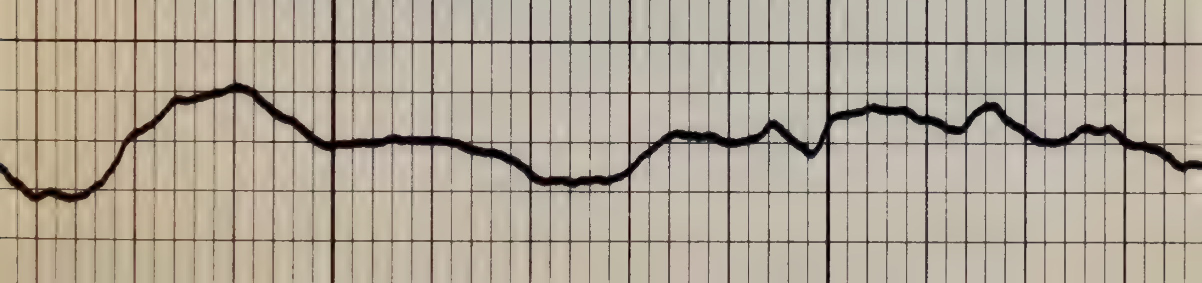
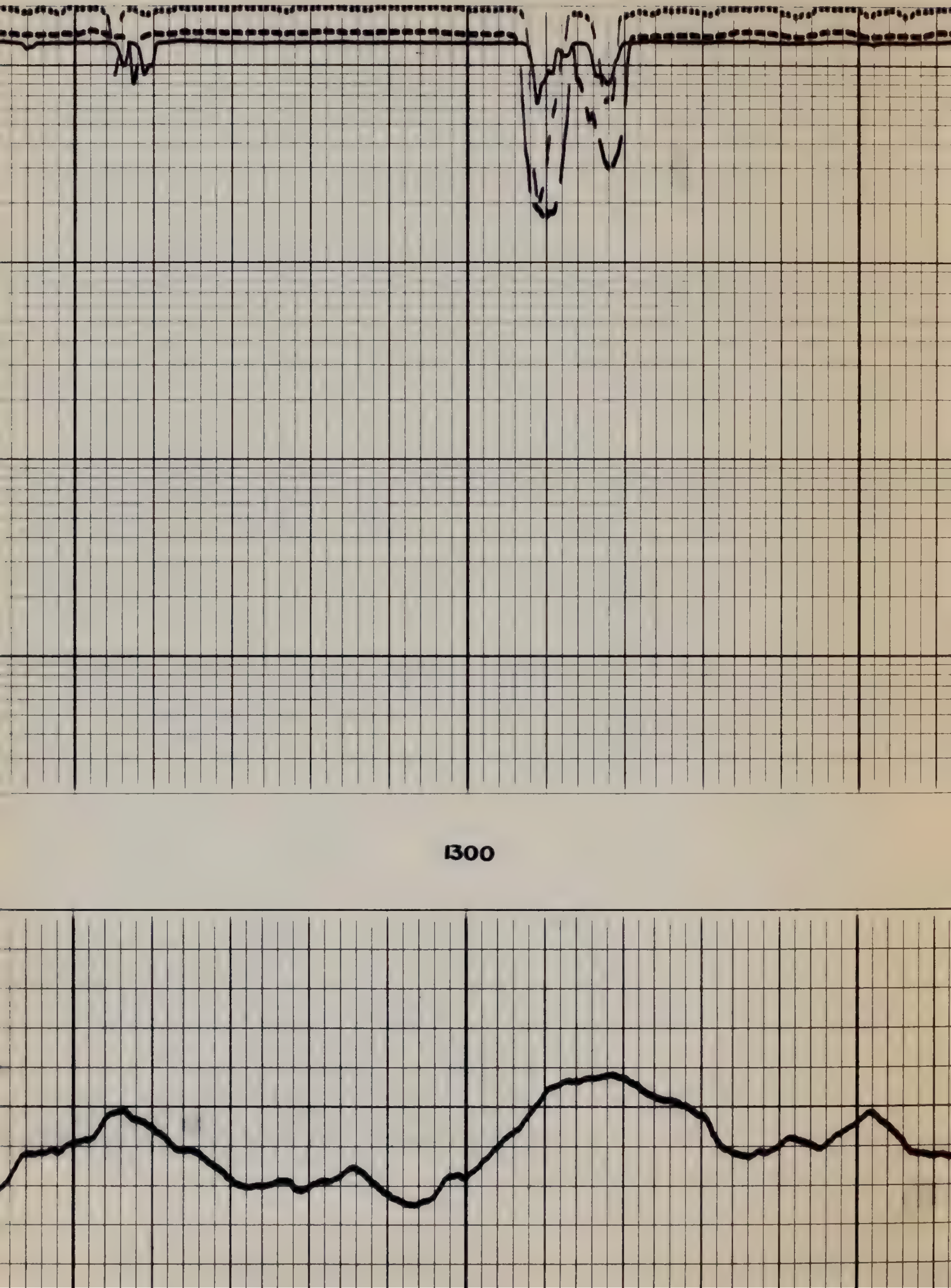

0900


1000
1100

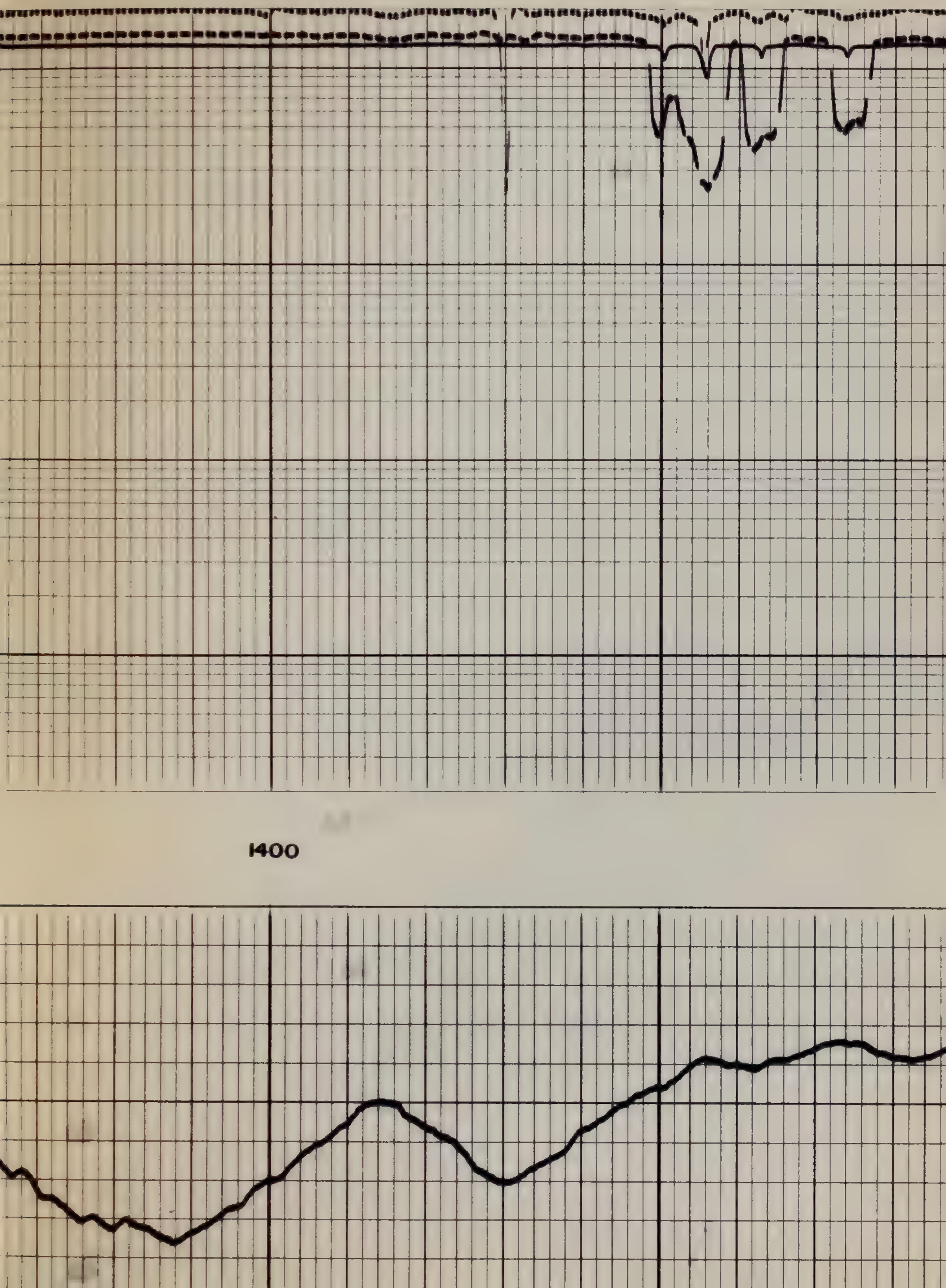


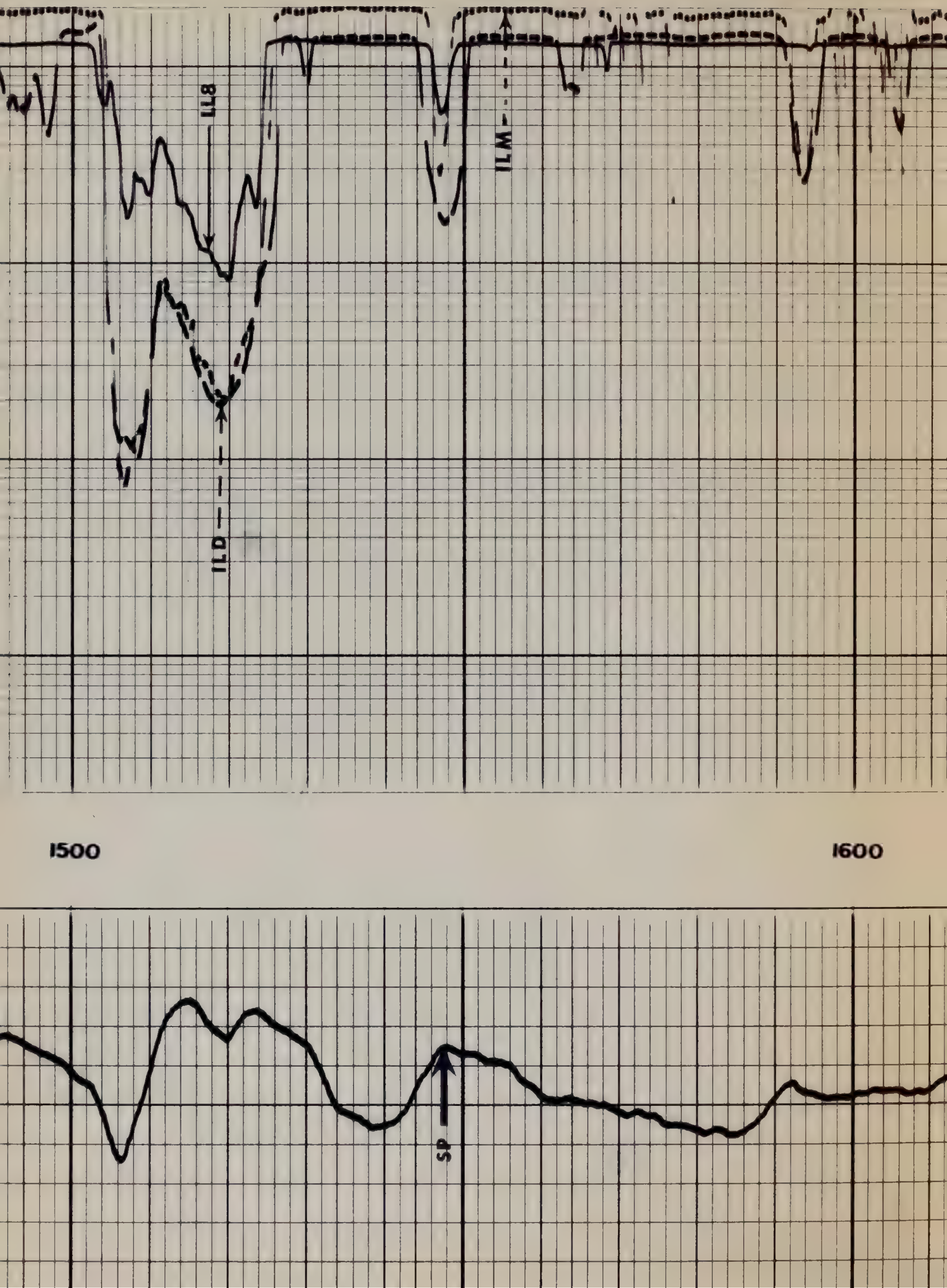
1200

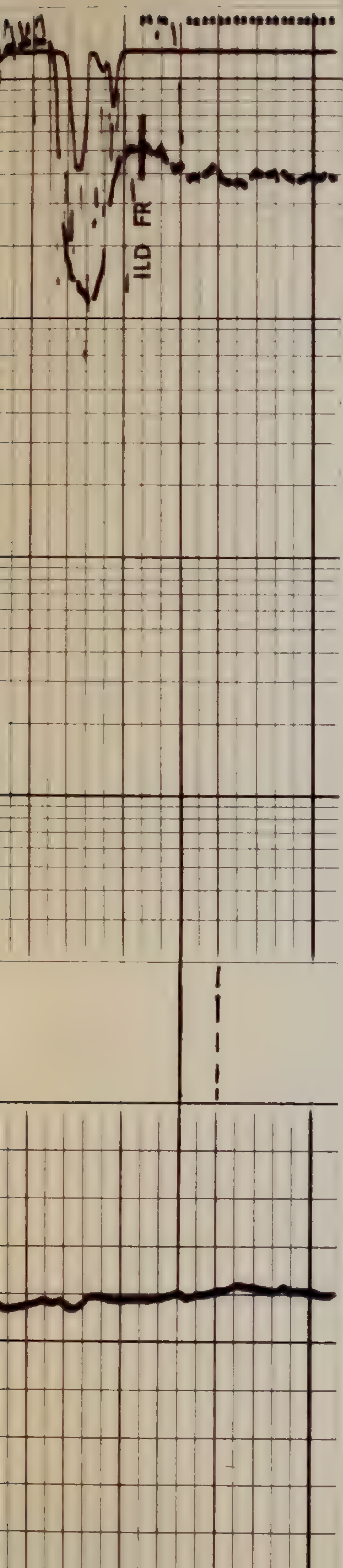


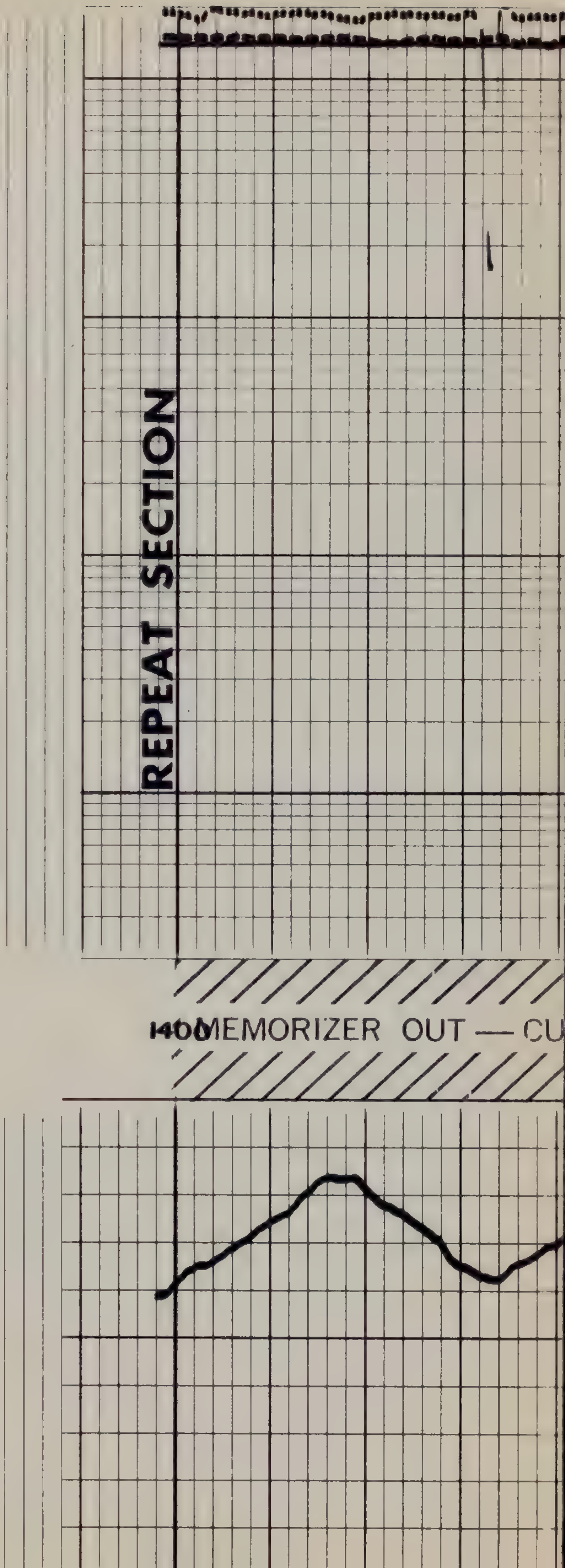


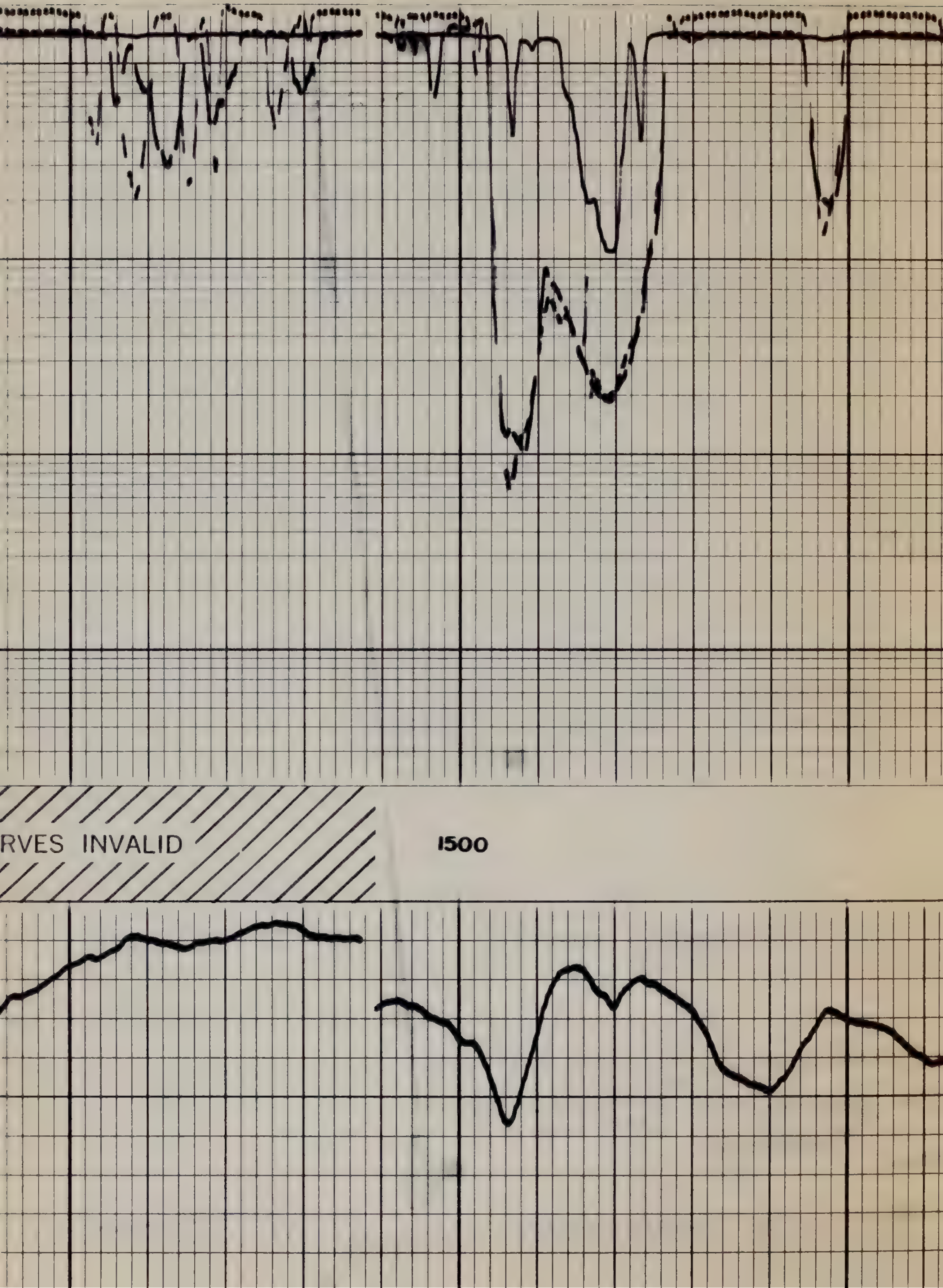
1300

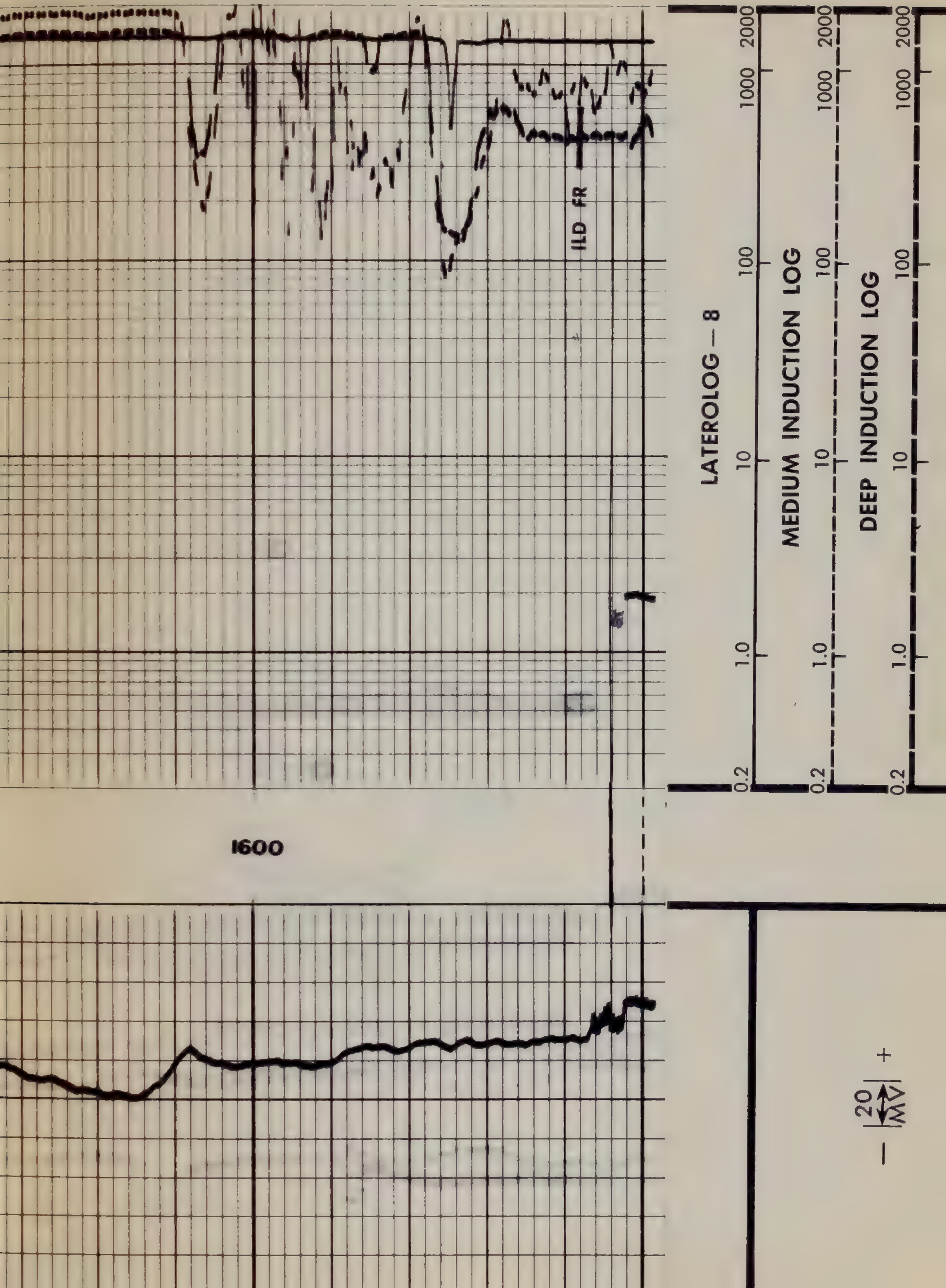

1400


IL8
ILM
ILD
1500
1600
SP


ILD FR


REPEAT SECTION
1400 MEMORIZER OUT — CU


RVES INVALID
1500


LATEROLOG — 8
0.2
1.0
10
100
1000
2000
MEDIUM INDUCTION LOG
0.2
1.0
10
100
1000
2000
DEEP INDUCTION LOG
0.2
1.0
10
100
1000
2000
ILD FR
1600
– 20 MV +

SPONTANEOUS-POTENTIAL MILLIVOLTS	DEPTHS	RESISTIVITY OHMS. M^2/M

COMPANY THE ATLANTIC RICHFIELD COMPANY

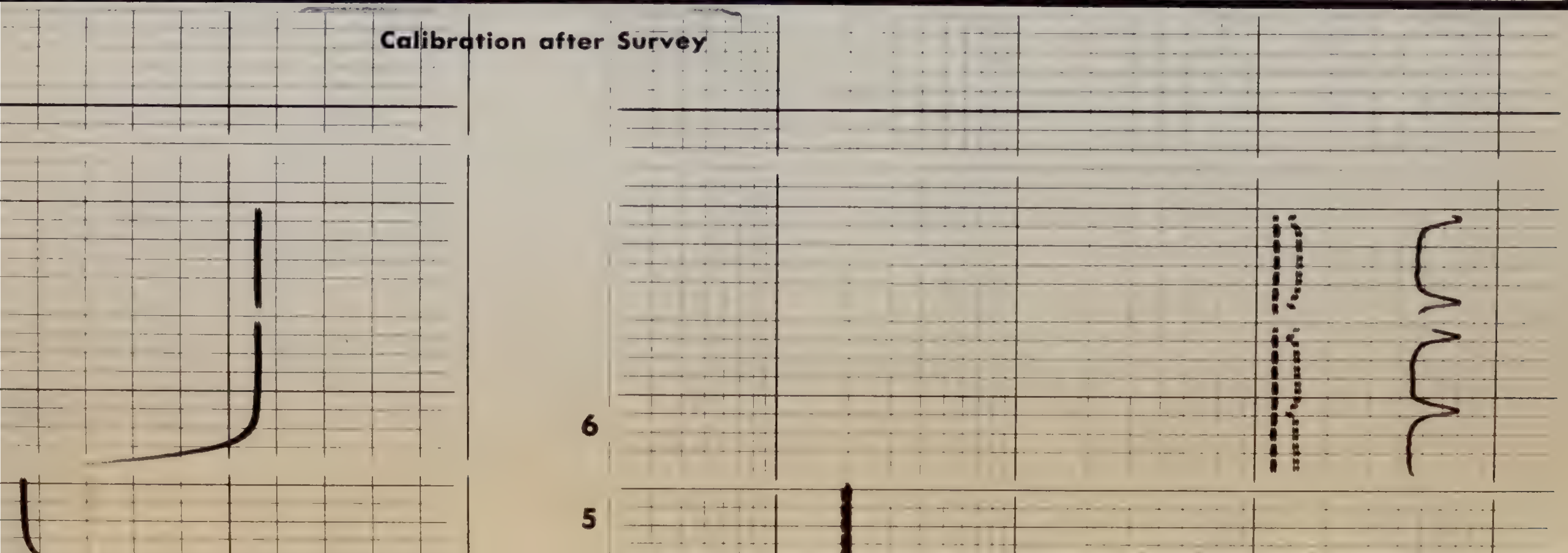
WELL AQUIFER TEST NO. 1-B

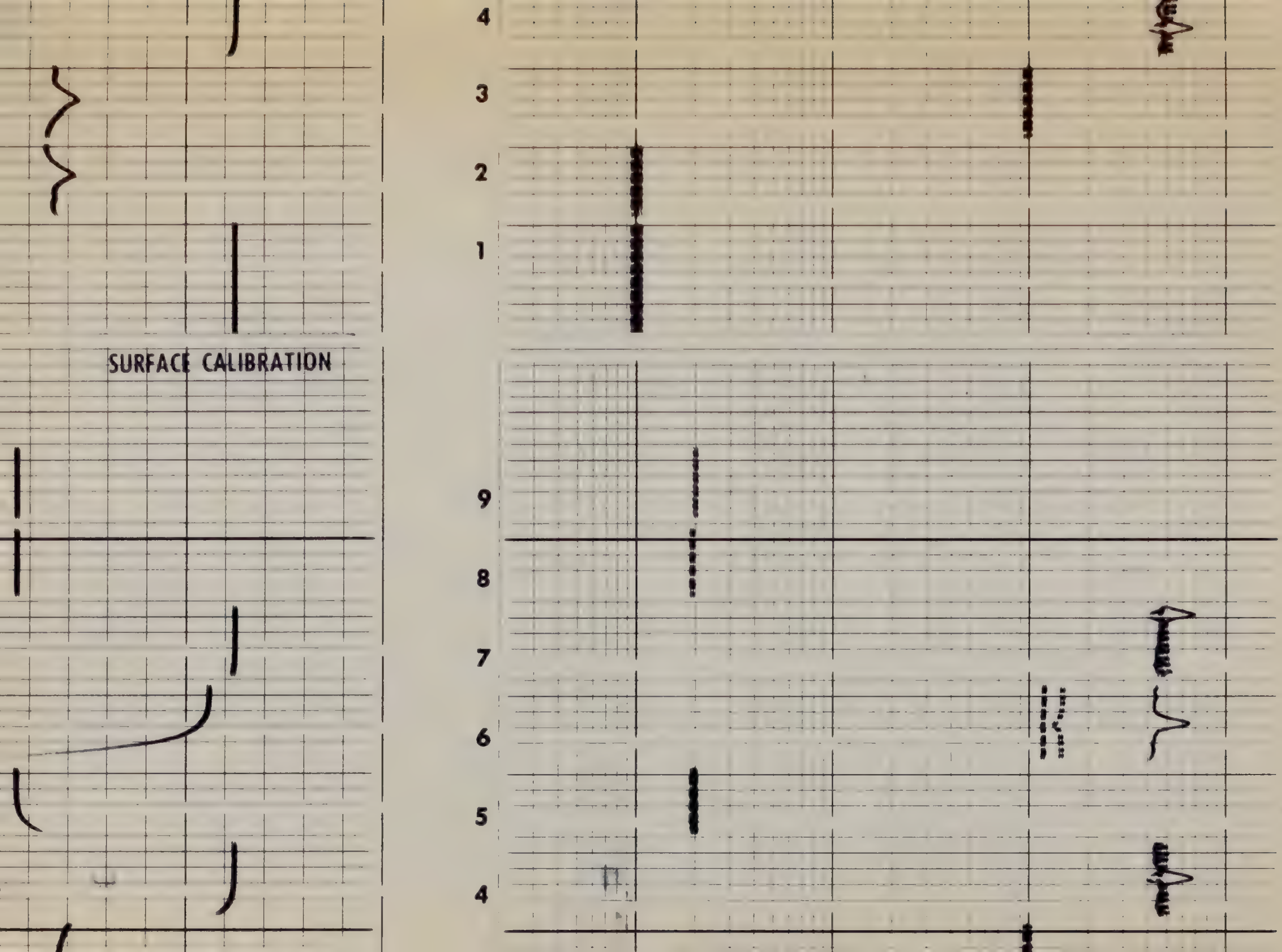
FIELD ----

COUNTY RIO BLANCO STATE COLORADO

SCHL. FR 1636
SCHL. TD 1640
DRLR TD 1638
Elev:
KB ----
DF ----
GL 6909

CALIBRATION RECORD




SURFACE CALIBRATION
4
3
2
1
9
8
7
6
5
4

Schlumberger

COMPENSATED FORMATION DENSITY LOG
Gamma-Gamma

COUNTY RIO BLANCO
FIELD or LOCATION ----
WELL AQUIFER TEST NO. 1-B
COMPANY ATLANTIC RICHFIELD

COMPANY THE ATLANTIC RICHFIELD COMPANY

WELL AQUIFER TEST NO. 1-B

FIELD ----

COUNTY RIO BLANCO STATE COLORADO

Location: API Serial No. 01036

Sec. 7 Twp. 3S Rge. 96W

Other Services:
DIL ENG. PRO
CNL-GR
BHC-GR

Permanent Datum: GL ; Elev.: 6909
Log Measured From GL , 0 Ft. Above Perm. Datum
Drilling Measured From GL

Elev.: K.B. ----
D.F. ----
G.L. 6909

Date		7-21-74							
Run No.		ONE							
Depth—Driller		1638							
Depth—Logger		1641							
Btm. Log Interval		1640							
Top Log Interval		72							
Casing—Driller		8-5/8@ 60		@		@		@	
Casing—Logger		72							
Bit Size		7-7/8							
Type Fluid in Hole		WATER							
Fluid Level		410							
Dens.	Visc.	8.3	---						
pH	Fluid Los	---	-- ml		ml		ml		ml
Source of Sample									
R_m @ Meas. Temp.		@ °F		@ °F		@ °F		@ °F	
R_{mf} @ Meas. Temp.		@ °F		@ °F		@ °F		@ °F	
R_{mc} @ Meas. Temp.		@ °F		@ °F		@ °F		@ °F	
Source: R_{mf}	R_{mc}								
R_m @ BHT		@ °F		@ °F		@ °F		@ °F	
Time Since Circ.		26 HRS.							
Max. Rec. Temp.		90 °F		°F		°F		°F	
Equip.	Location	5602	G.J.						
Recorded By		SCHNORR							
Witnessed By		TAIT							

CHANGES IN MUD TYPE OR ADDITIONAL SAMPLES

Date	Sample No.			
Depth - Driller				
Type Fluid				
Source of Sample				
R_m @ Meas. Temp.		@ °F		@ °F
R_{mf} @ Meas. Temp.		@ °F		@ °F
R_{mc} @ Meas. Temp.		@ °F		@ °F
R_m @ BHT		@ °F		@ °F
Dens.	Visc.			
ph	Fluid Loss	ml		ml
% Water by Vol.				
% Oil by Vol.				
% Solids by Vol.				
Solids Av. Sp. Gr.				

EQUIPMENT DATA

Run No.	ONE			
Panel No.	EA-169			
Cart No.	EA-289			
Skid No.	E-90			
Sonde No.	P-436			
Source	3098			
Calibrator	210			
GR Cart.	KG-311			
TTR	----			
Mem Panel	B-260			

BIT SIZE CASING DATA

Bit	From	To	Csg. Size	Csg. Wt.	From	To
7-7/8	1638	60	8-5/8		60	GL

SCALE CHANGES

Type Log	Depth	Scale Up Hole	Scale Down Hole

LOGGING DATA

FDC Selectors

Liquid Density	Grain Density	Hole Fluid	Porosity Scale	From	To
1.00	2.71	WATER	30/TK	1640	410
.82	2.71	AIR	30/TK	410	72

REMARKS

Service Order No. - SO #1036

RATIO CAL. = 2.29

CALIBRATION DATA

Run No.	Gamma Ray			FDC — Before Log — ACPS		FDC — After Log — ACPS	
	API Scale	Background CPS	Total CPS	P_1	P_2	P_1	P_2
1	0-150	180	560	512	752	512	752
2							
3							
4							

All interpretations are opinions based on inferences from electrical or other measurements and we cannot, and do not guarantee the accuracy or correctness of any interpretations, and we shall not, except in the case of gross or willful negligence on our part, be liable or responsible for any loss, costs, damages or expenses incurred or sustained by anyone resulting from any interpretation made by any of our officers, agents or employees. These interpretations are also subject to Clause 7 of our General Terms and Conditions as set out in our current Price Schedule.

CALIPER

HOLE DIAM. IN INCHES

6 16

DEPTHS

RATIO

5.0 2.5 0

-.25 0 .25

CORRECTION

GRAMS/CC.

GAMMA RAY

API UNITS

0 150

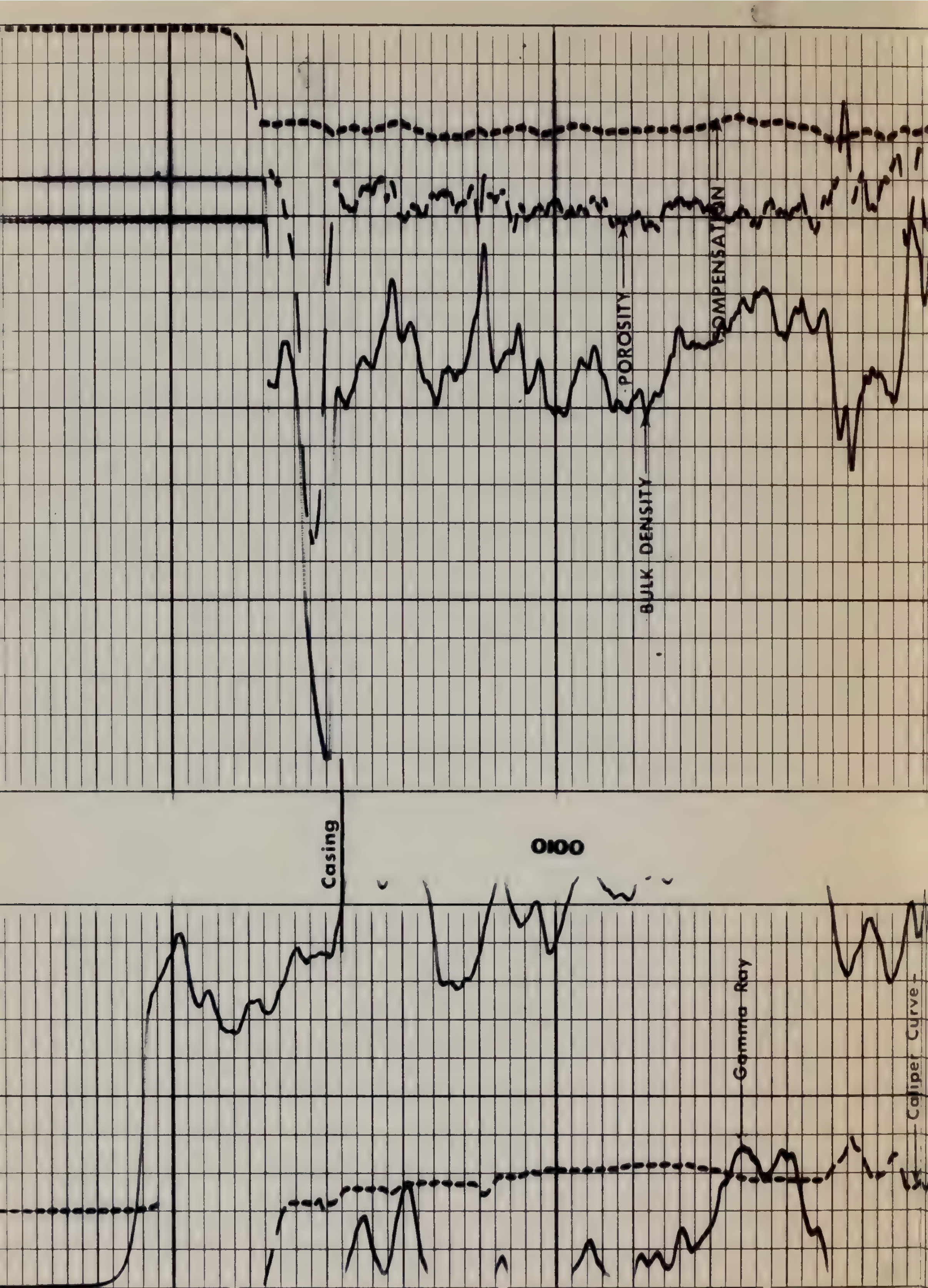
150 300

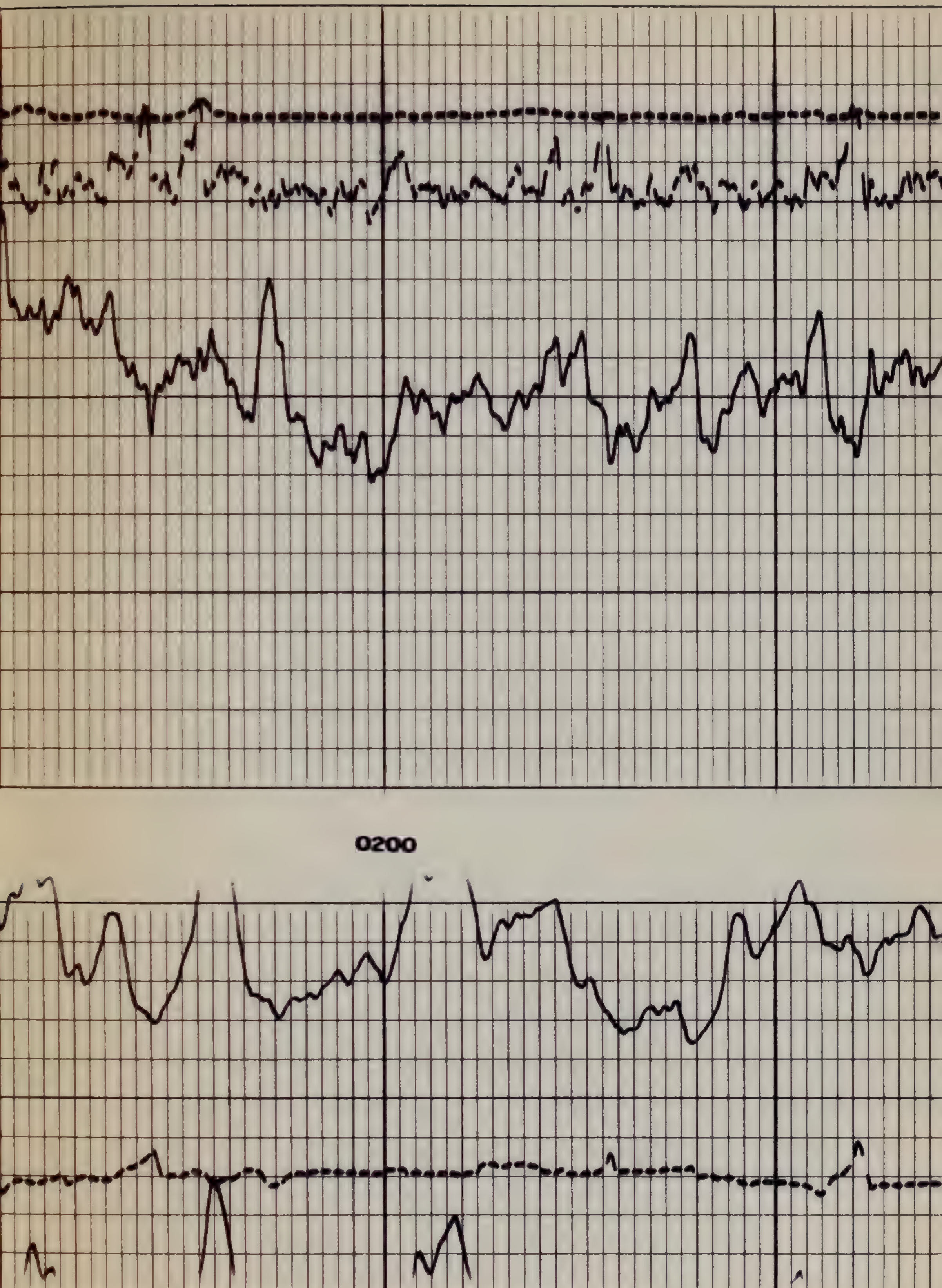
BULK DENSITY

GRAMS CC.

1.70 2.20 2.70

.70 1.20 1.70


POROSITY
BULK DENSITY
COMPENSATION
Casing
0100
Gamma Ray
Caliper Curve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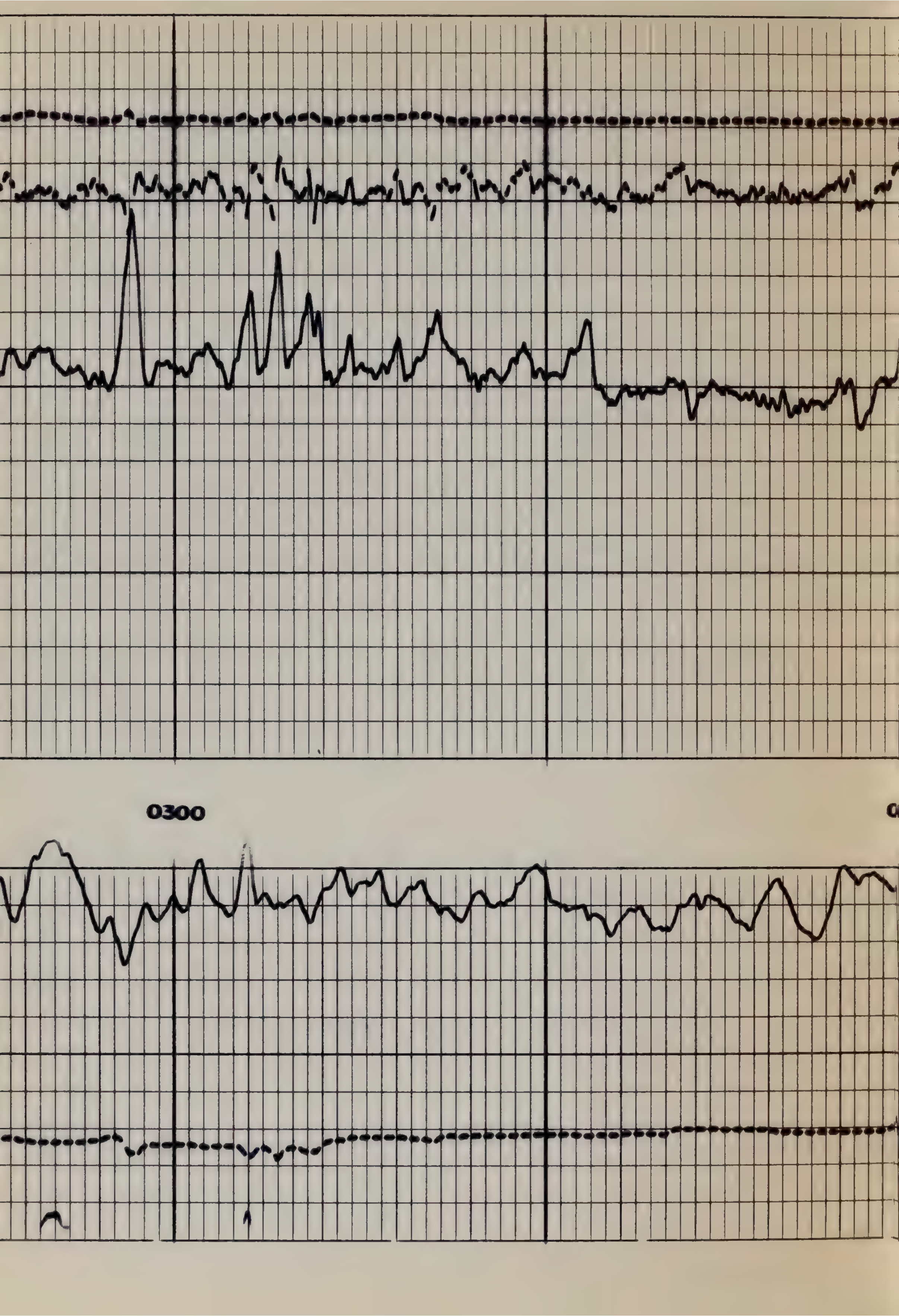
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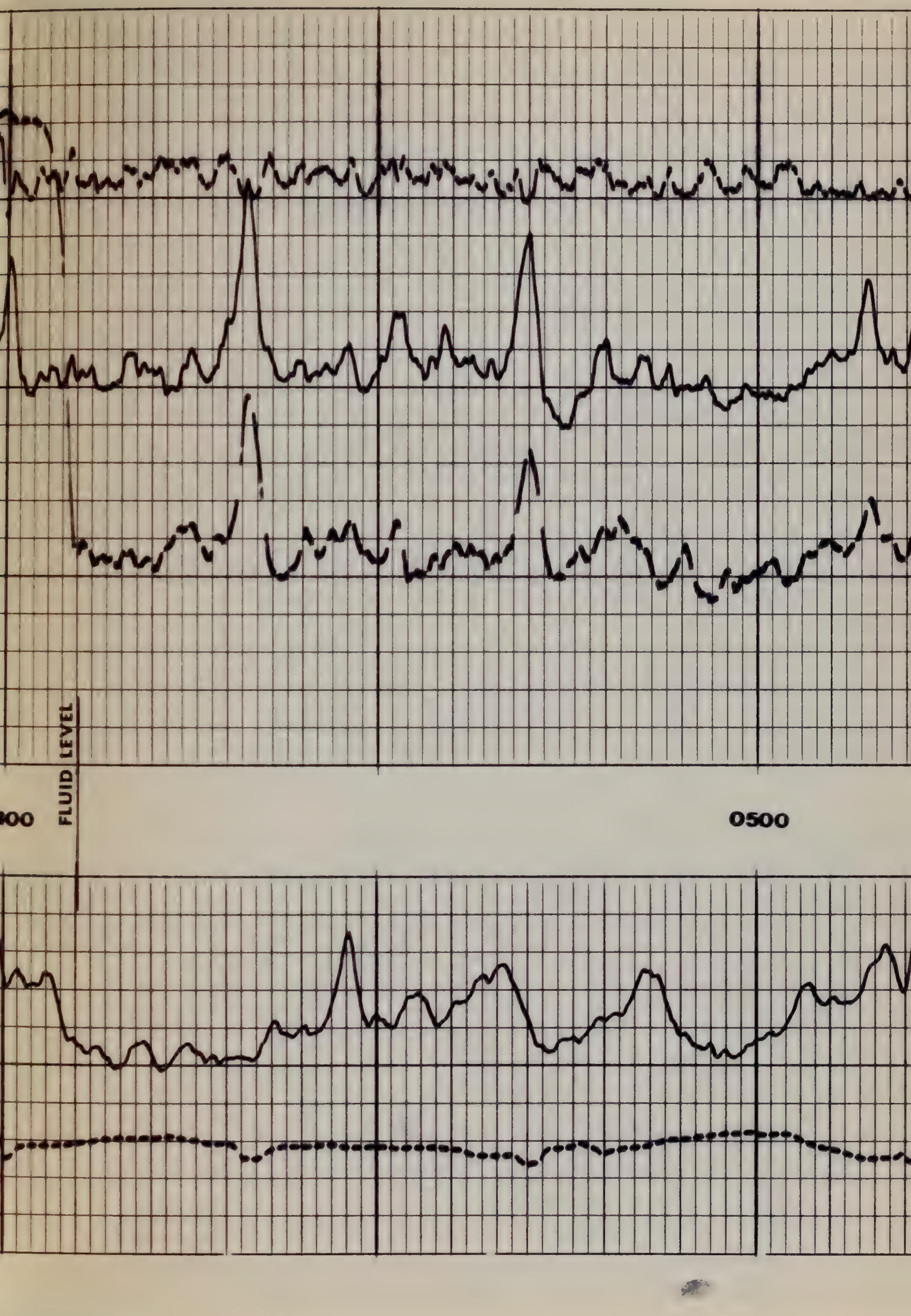
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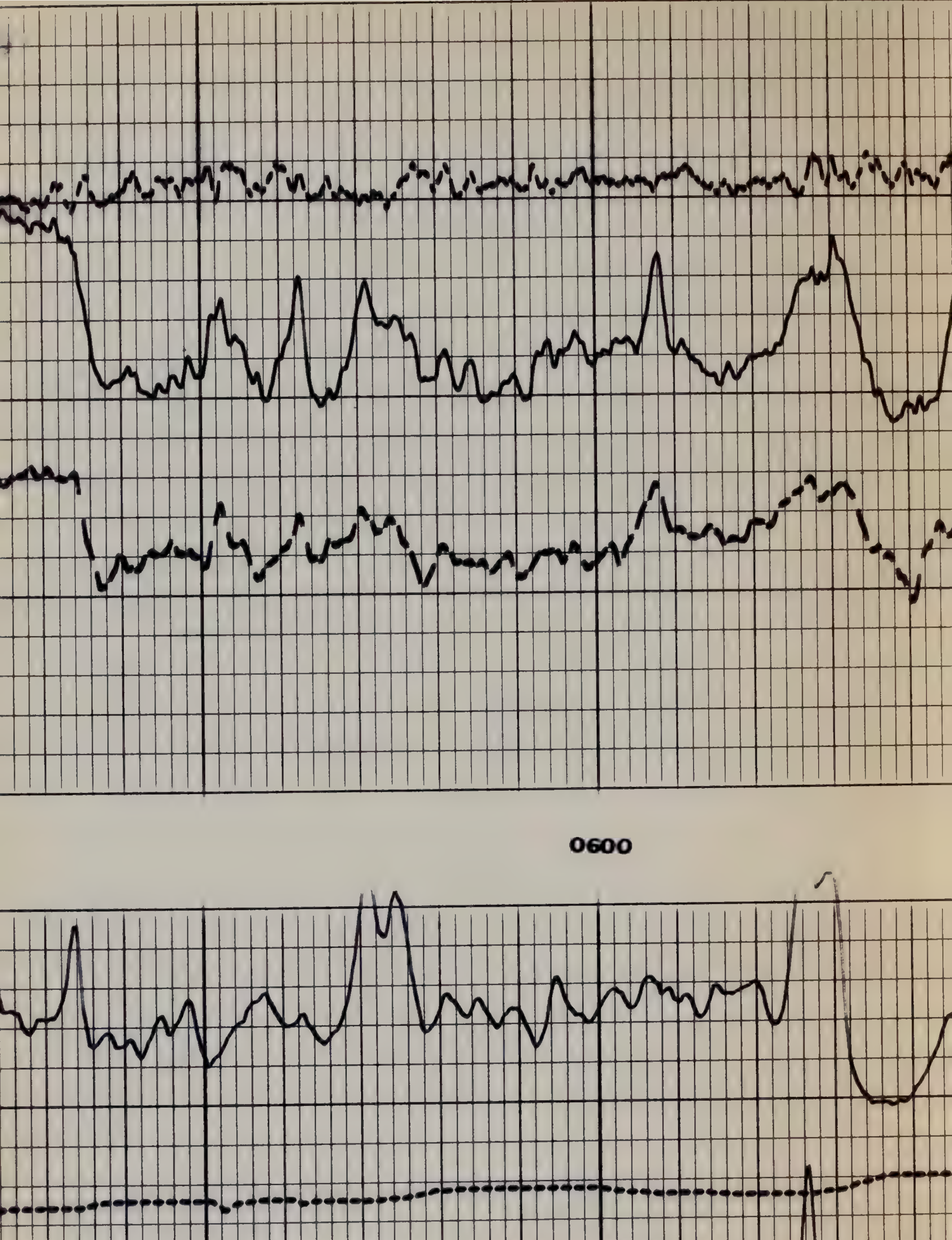
0500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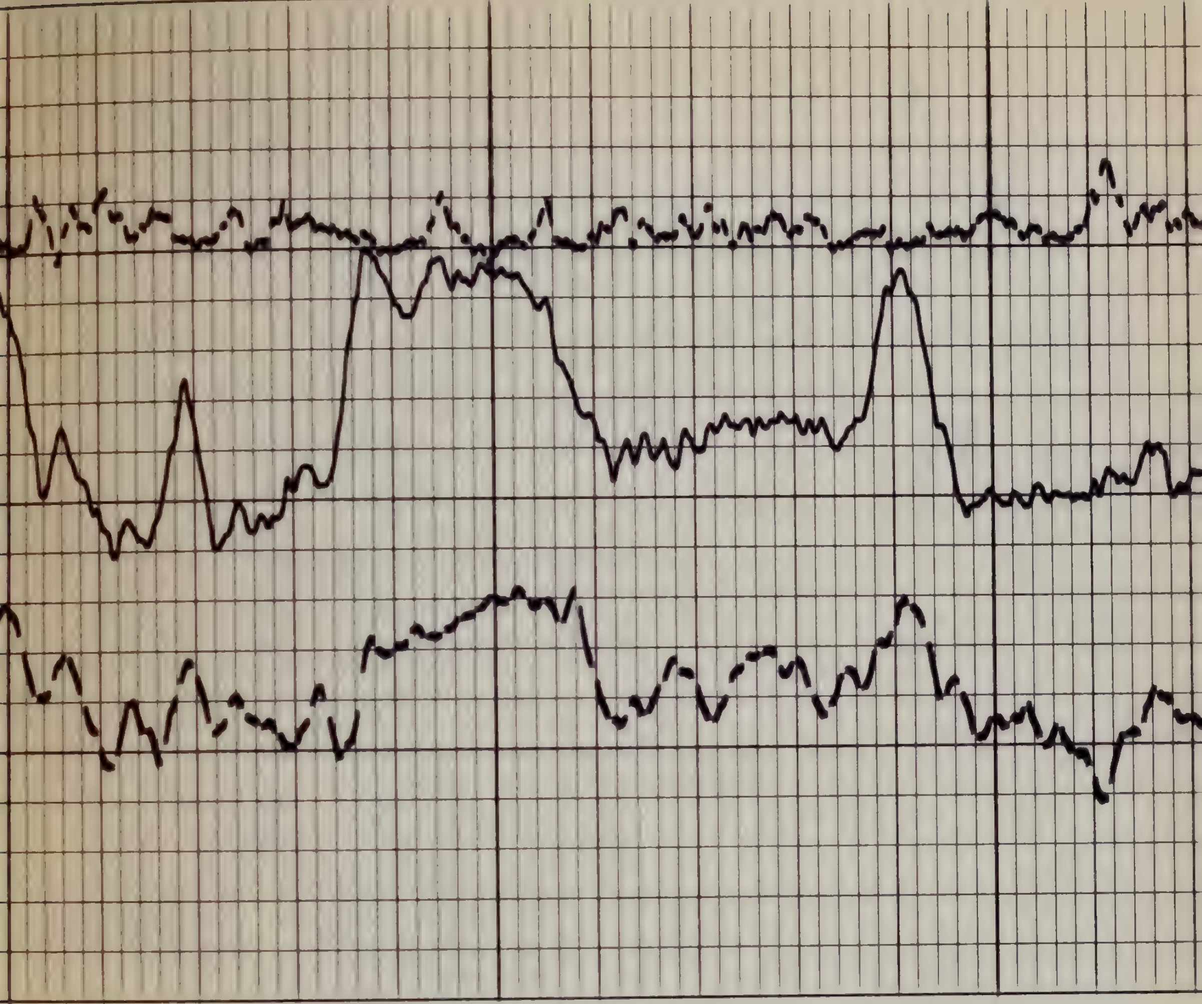

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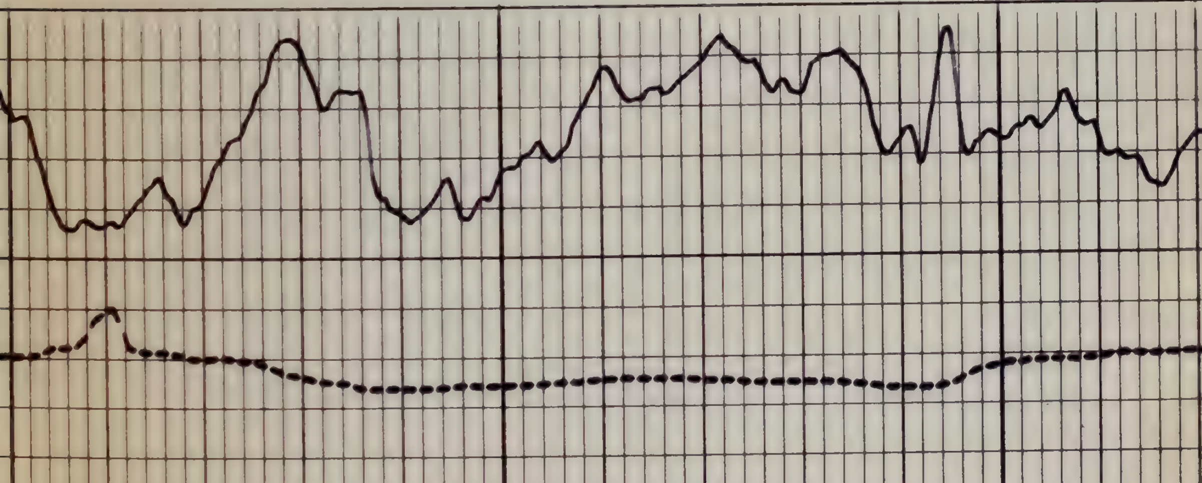

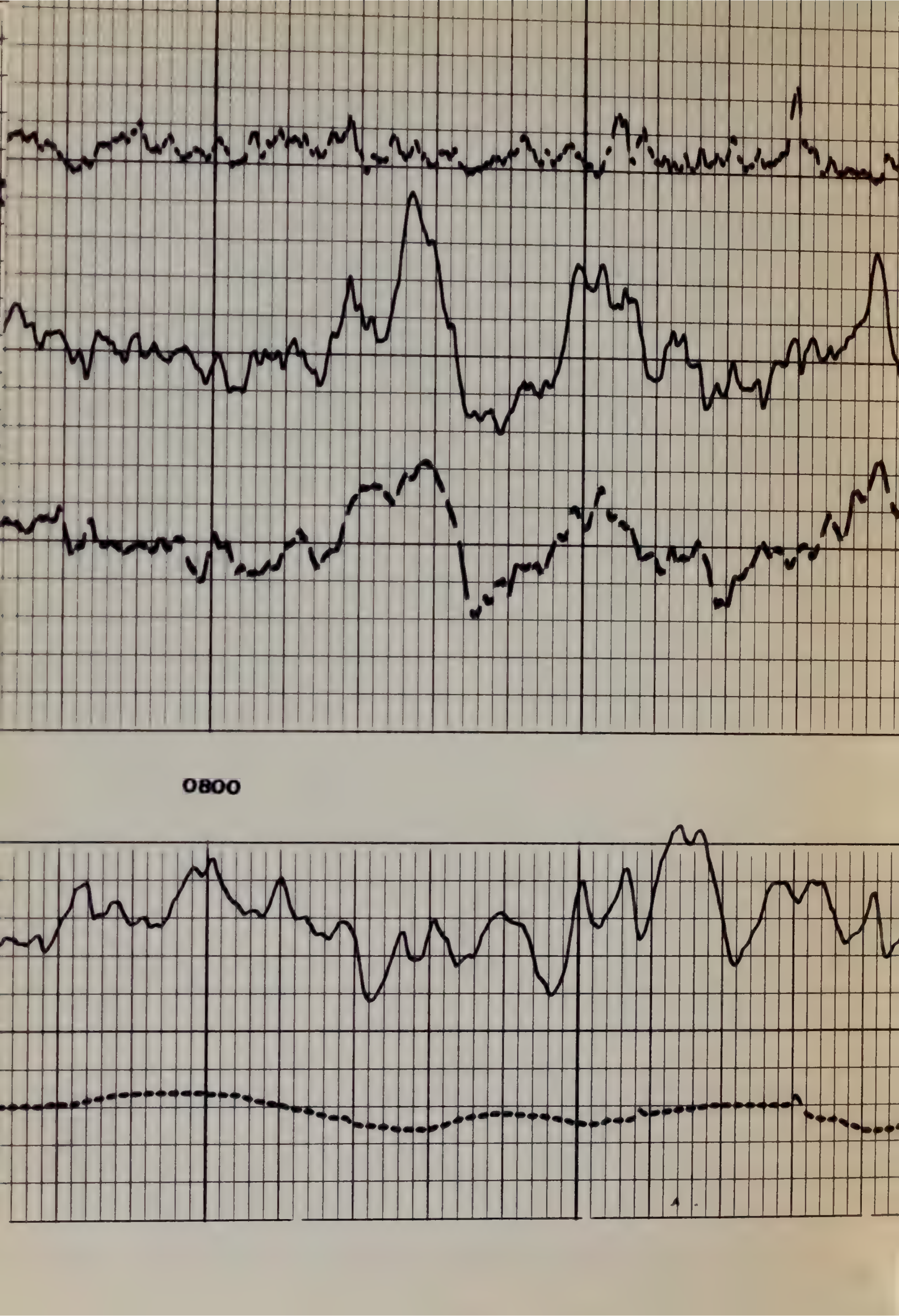
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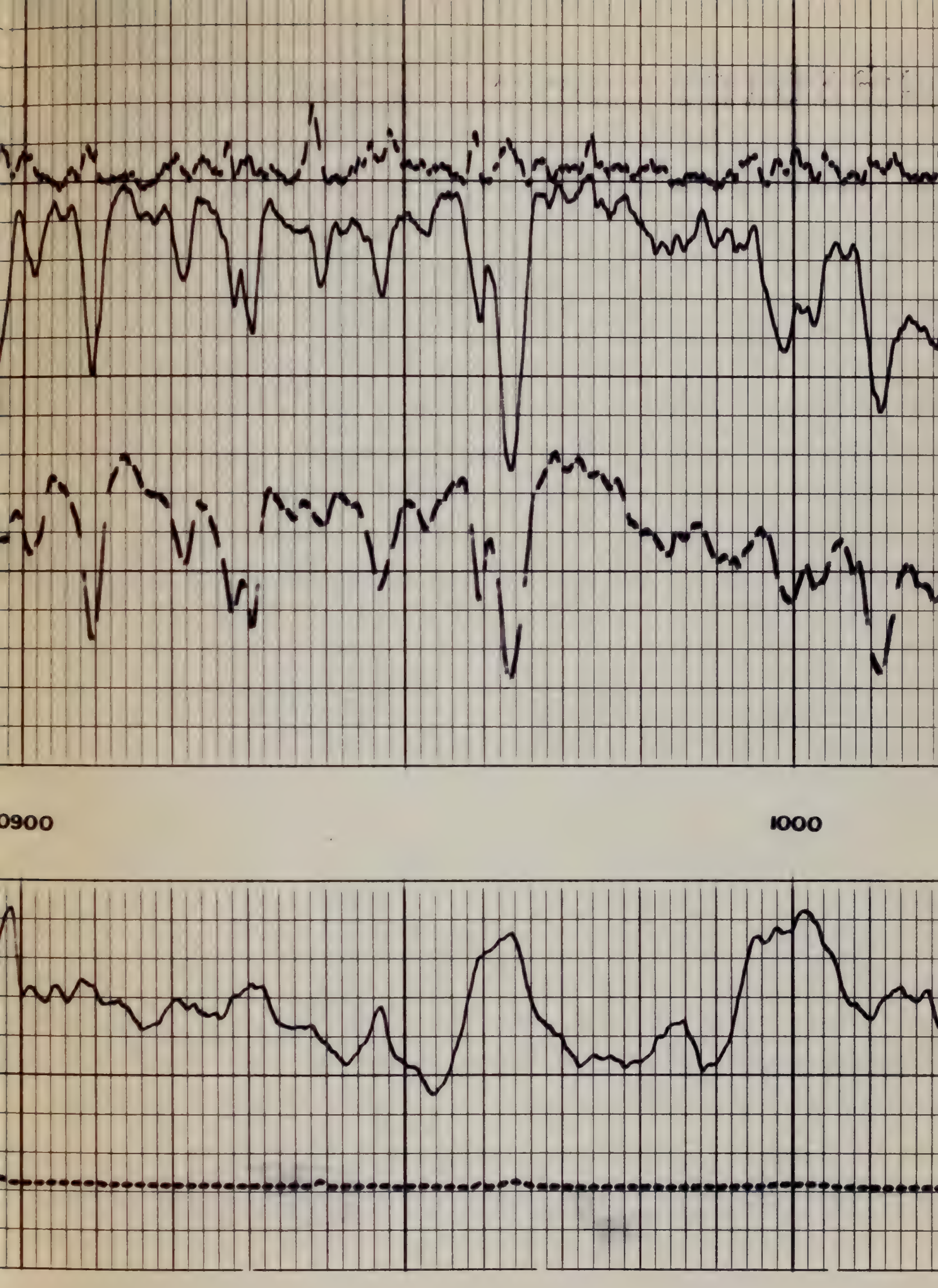
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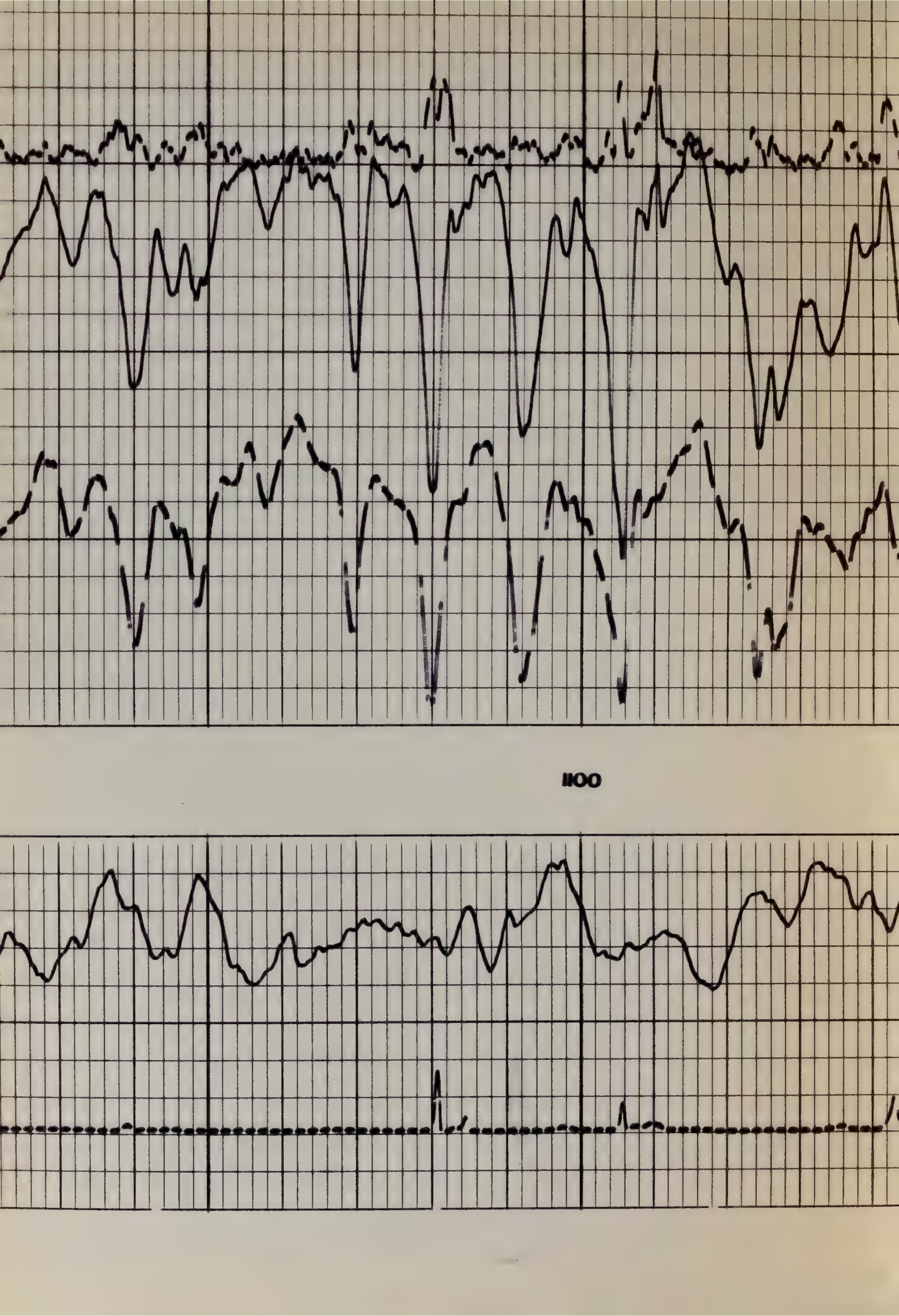
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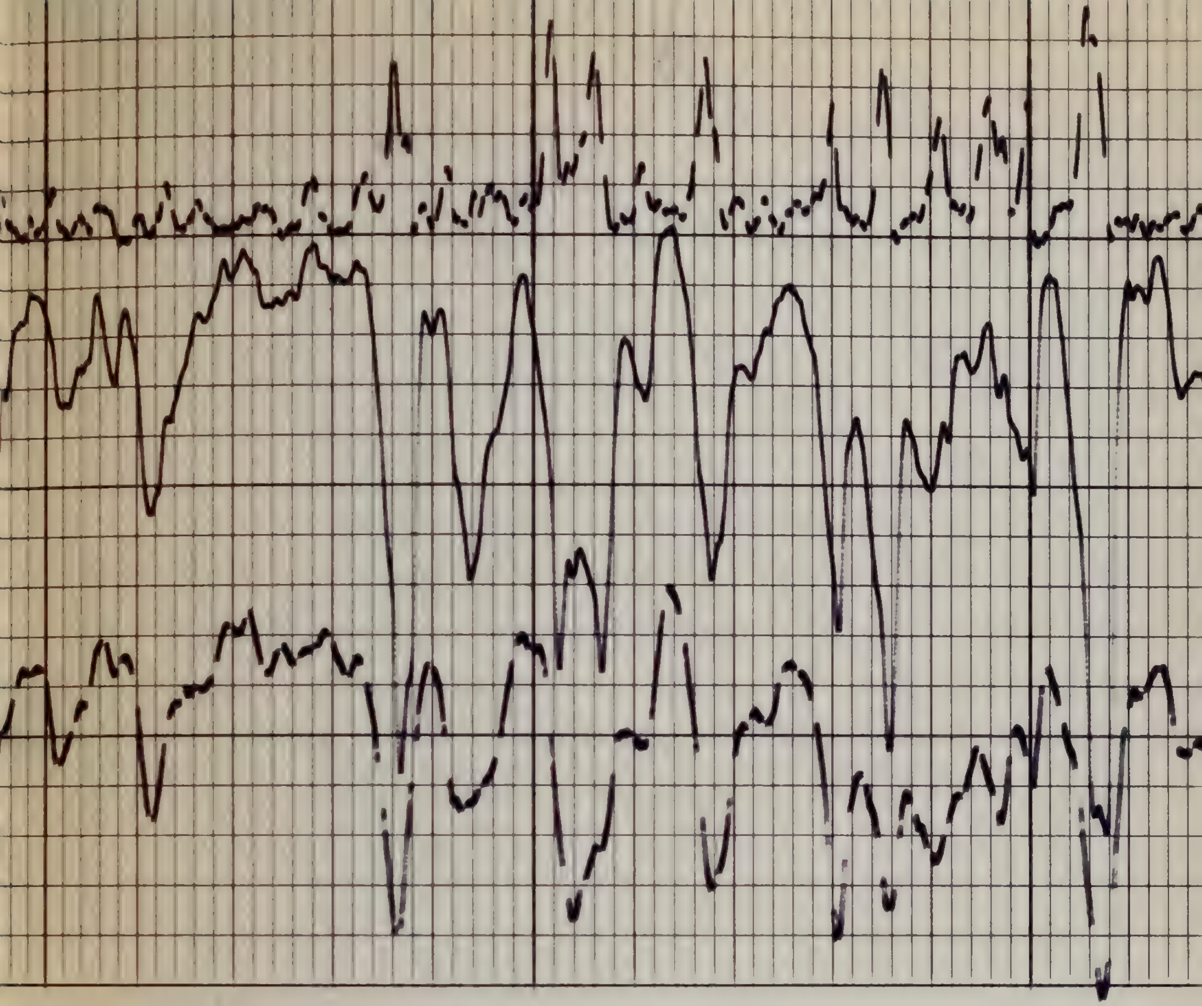

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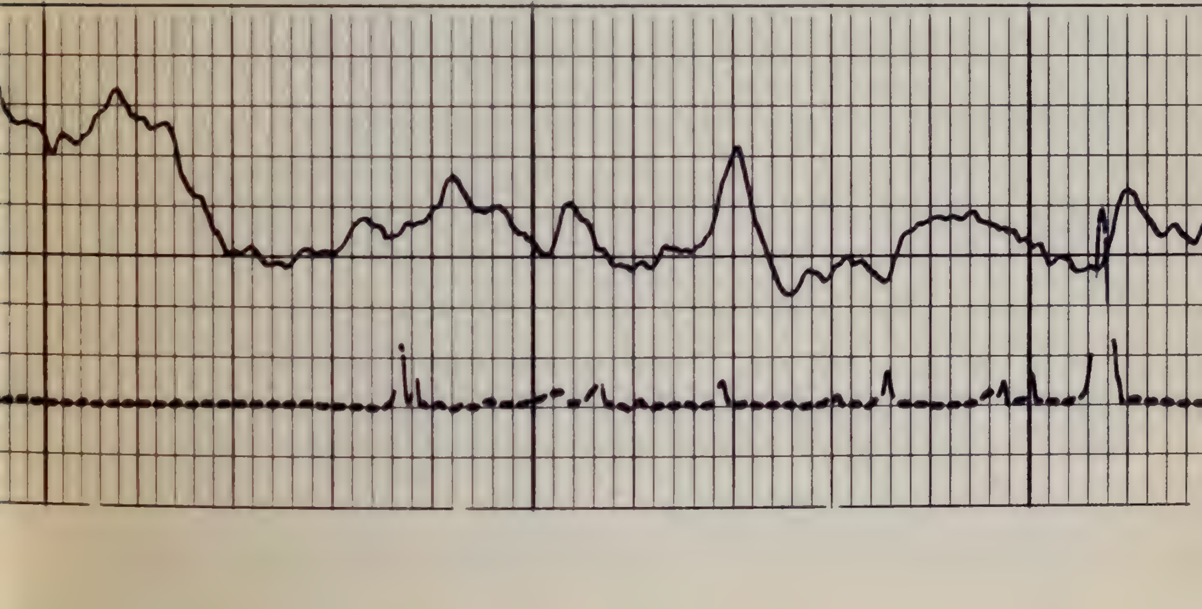

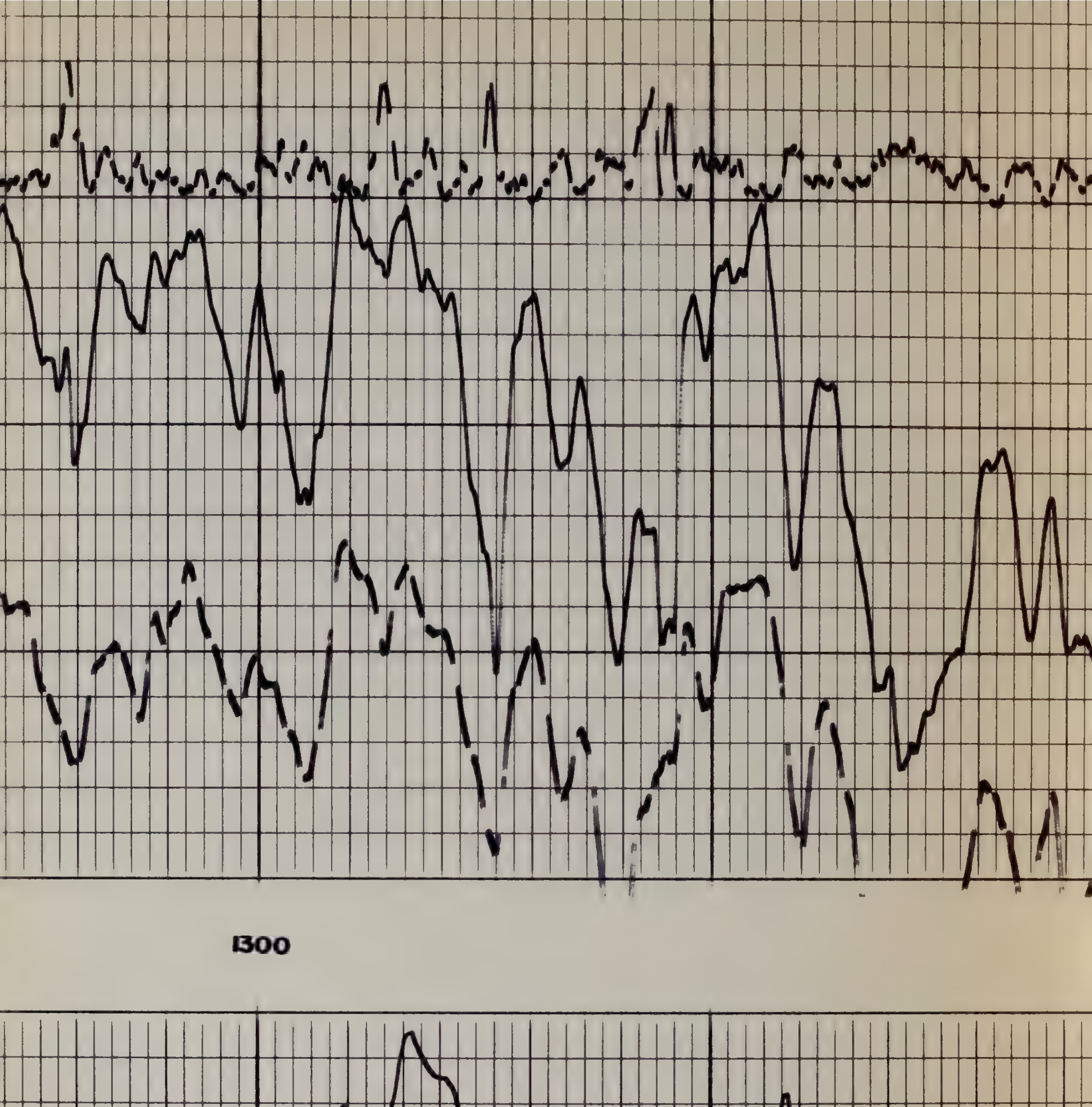

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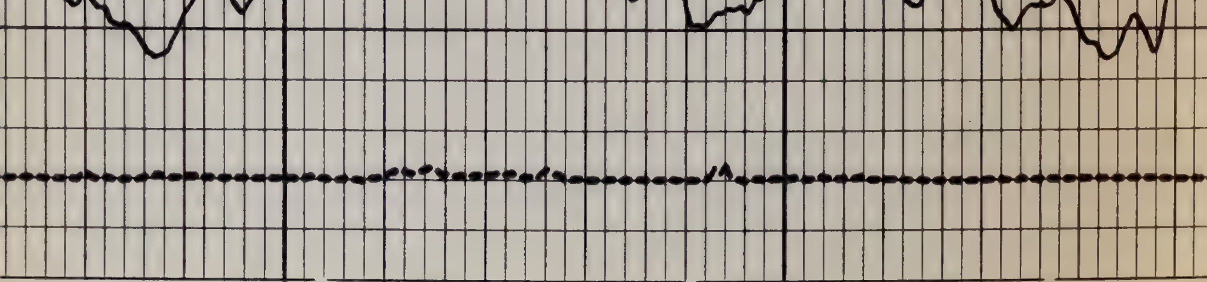

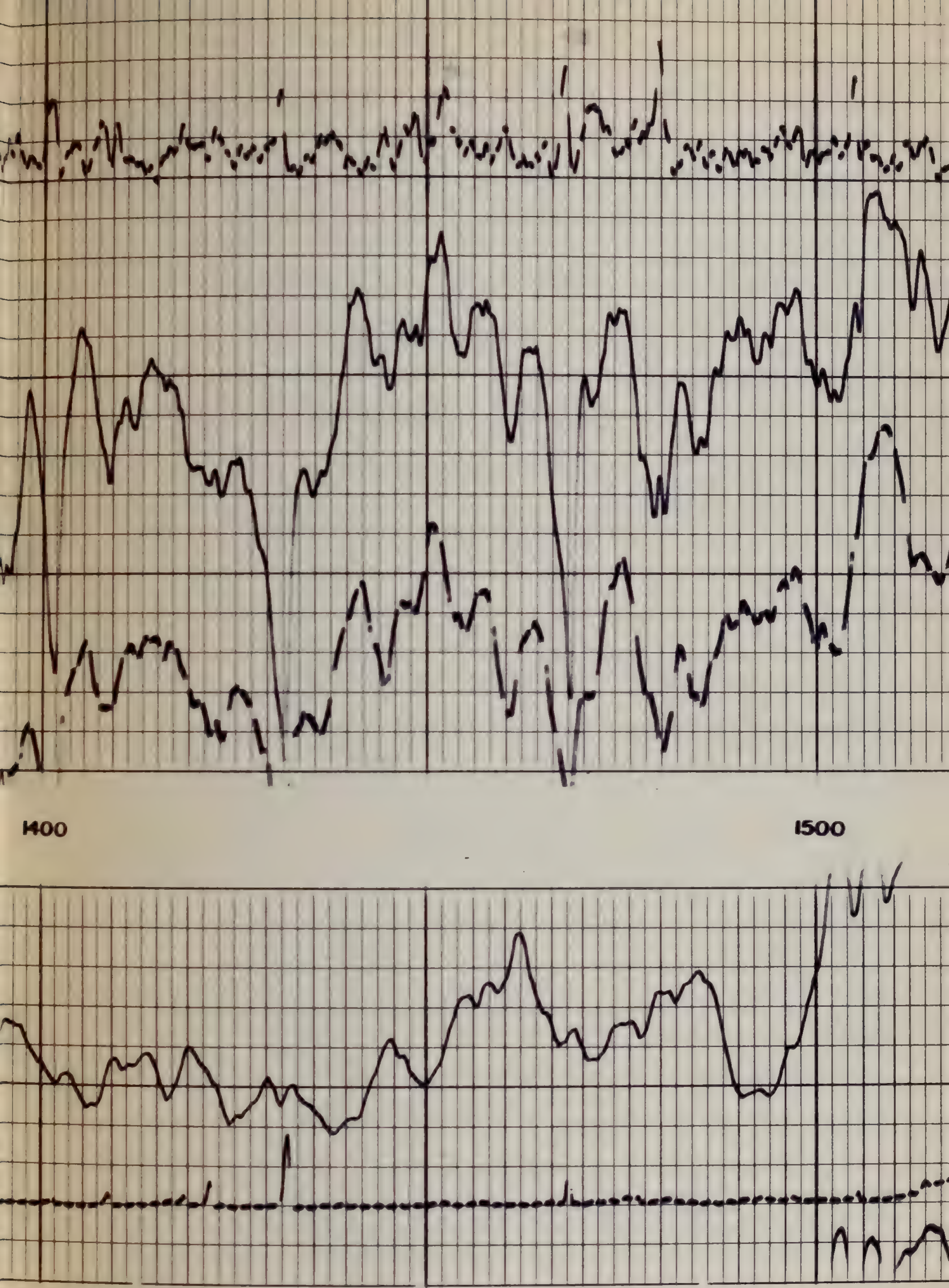
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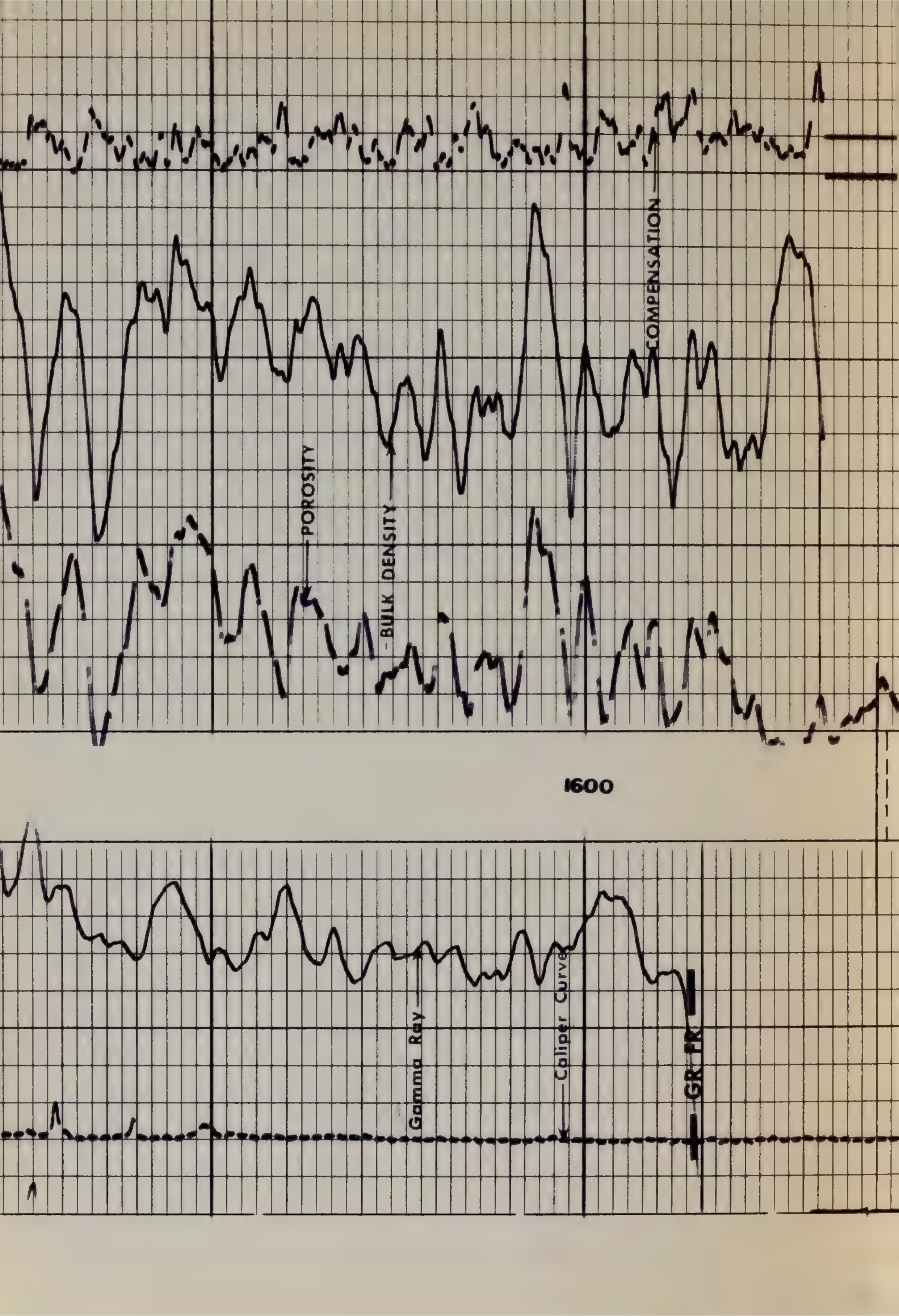
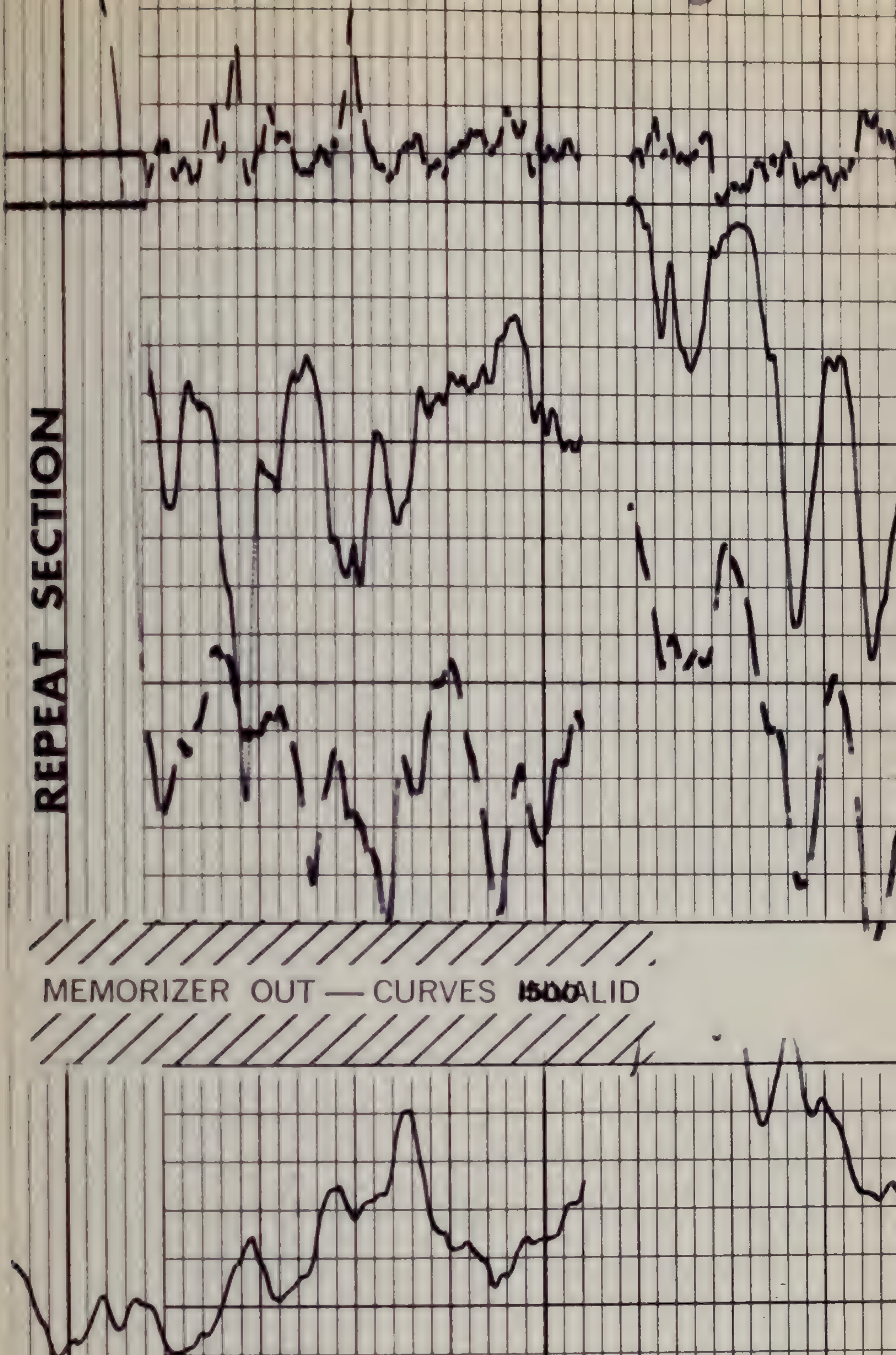
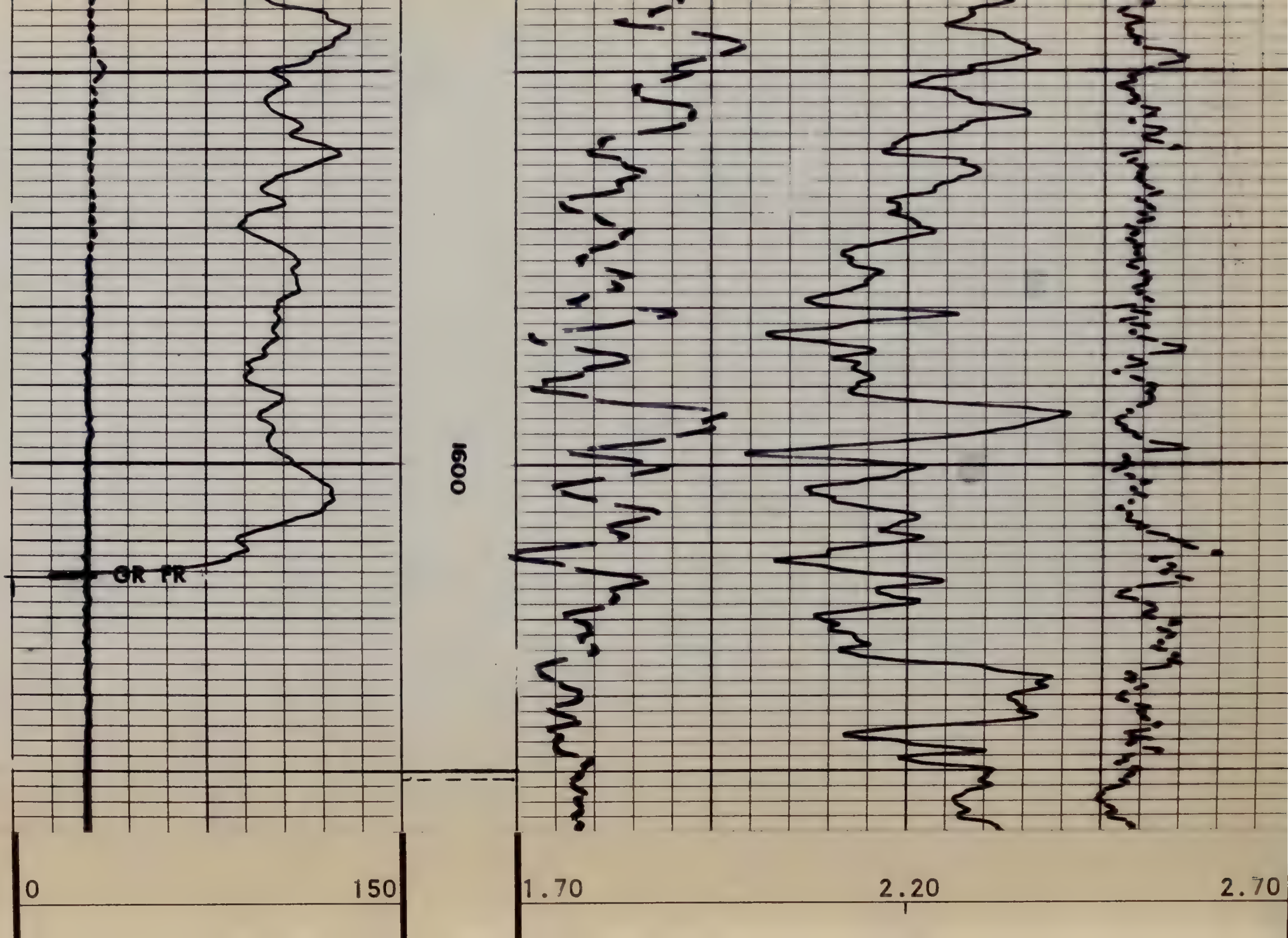
1500


COMPENSATION
POROSITY
BULK DENSITY
1600
Gamma Ray
Caliper Curve
GR FR


REPEAT SECTION
MEMORIZER OUT — CURVES INVALID
1500


1600
GR FR
0
150
1.70
2.20
2.70

150 300

GAMMA RAY

API UNITS

6 16

CALIPER

HOLE DIAM. IN INCHES

DEPTHS

.70 1.20 1.70

BULK DENSITY

GRAMS/CC.

−.25 0 +.25

CORRECTION

GRAMS/CC.

RATIO

5.0 2.5 0

COMPANY THE ATLANTIC RICHFIELD COMPANY

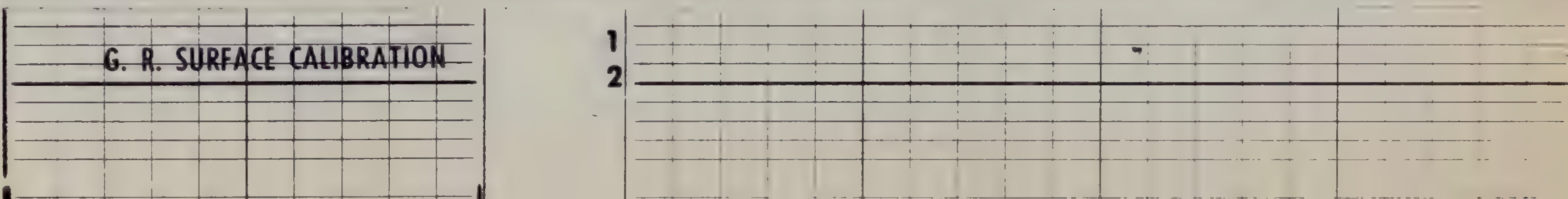
WELL AQUIFER TEST NO. 1-B

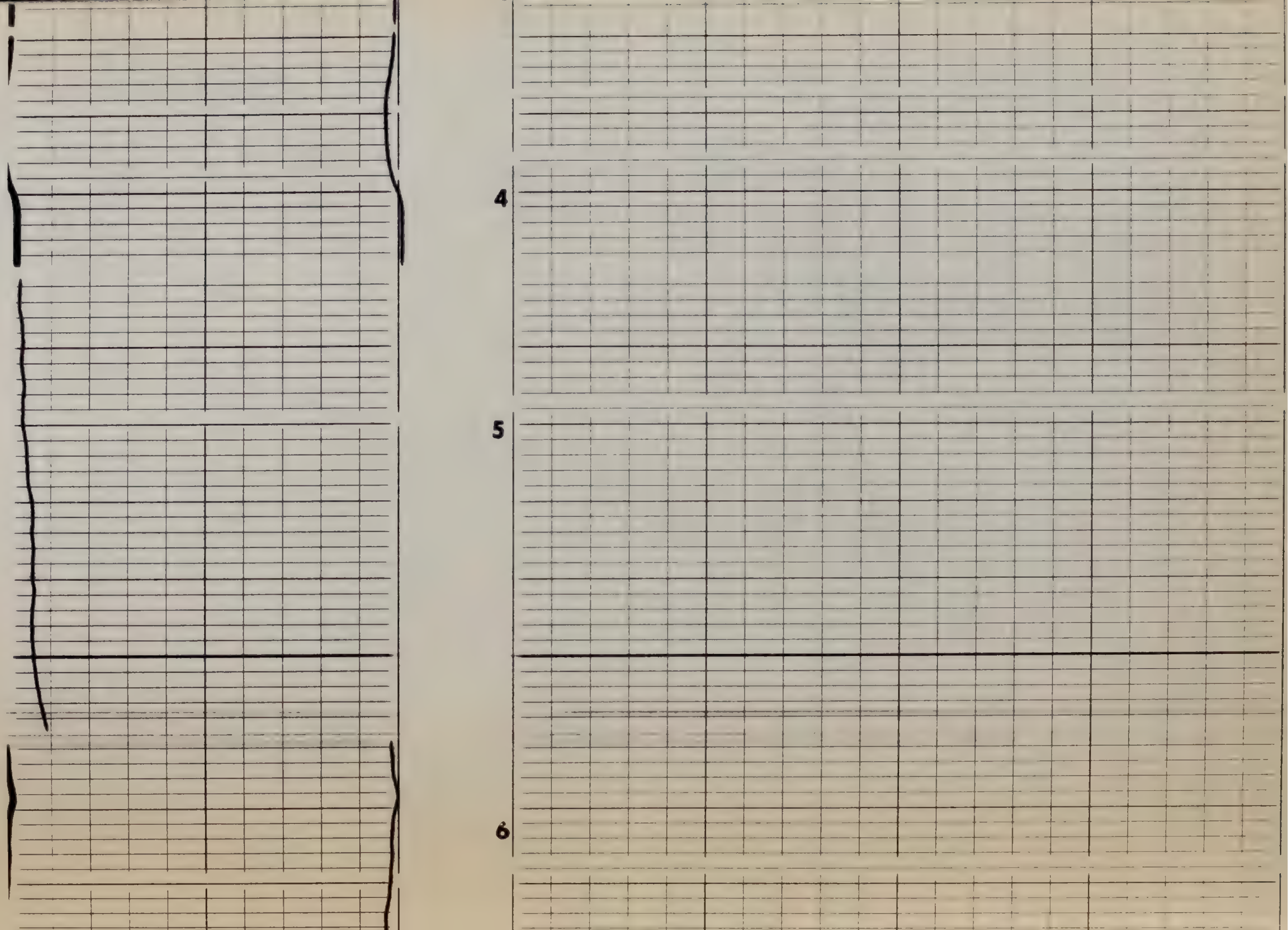
FIELD ----

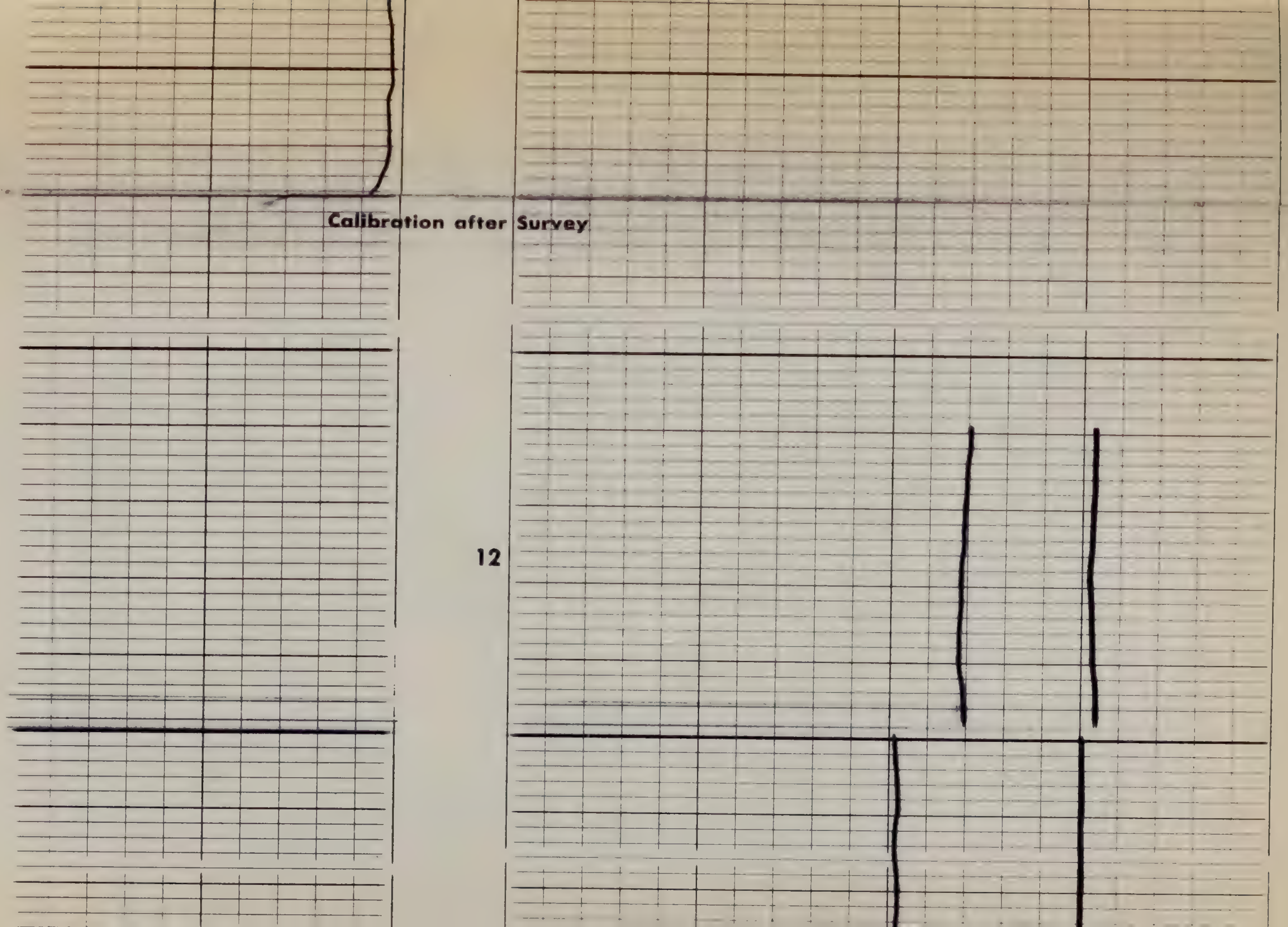
COUNTY RIO BLANCO STATE COLORADO

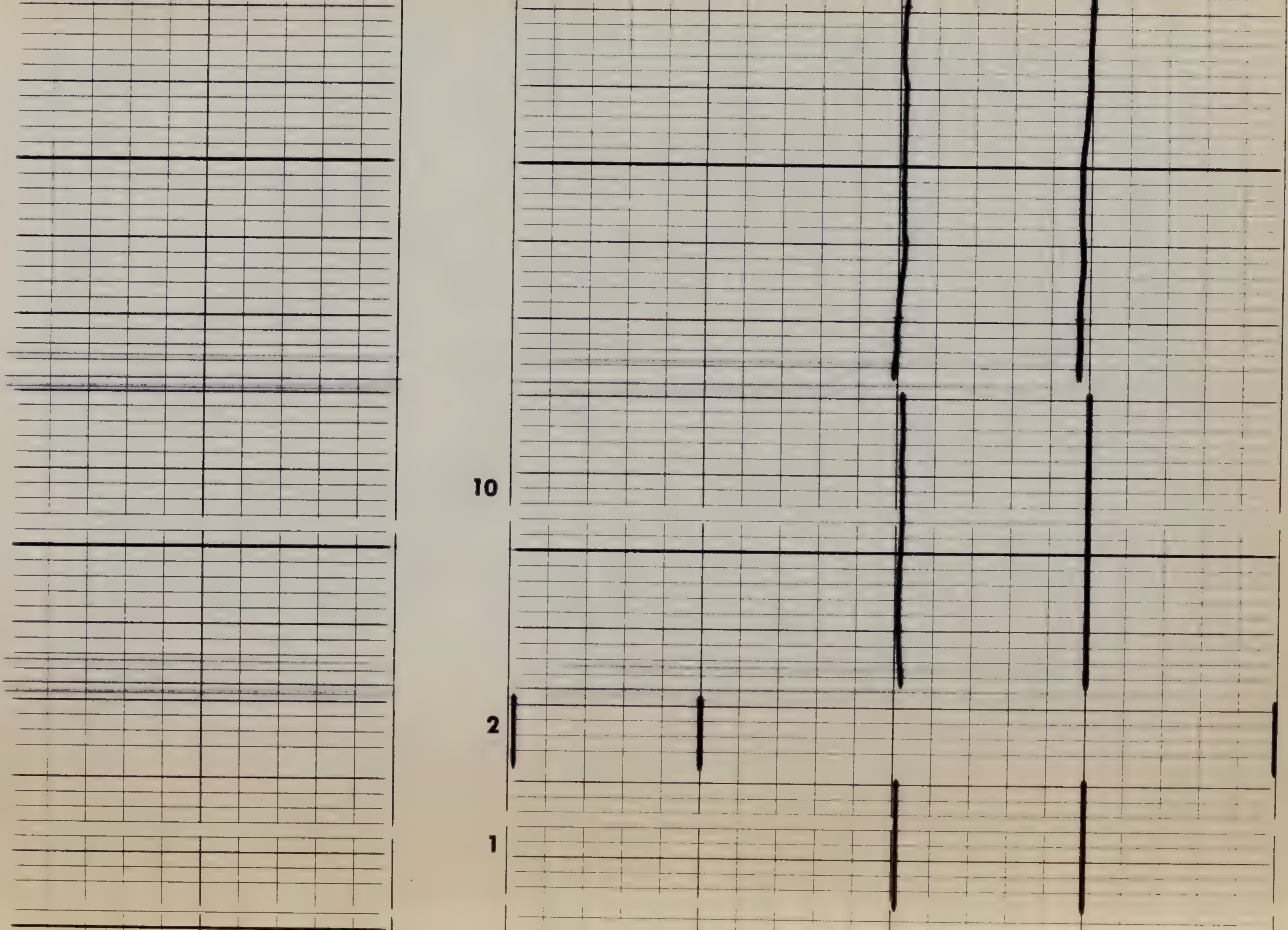
SCHL. FR 1640
SCHL. TD 1641
DRLR TD 1638
Elev:
KB ----
DF ----
GL 6909

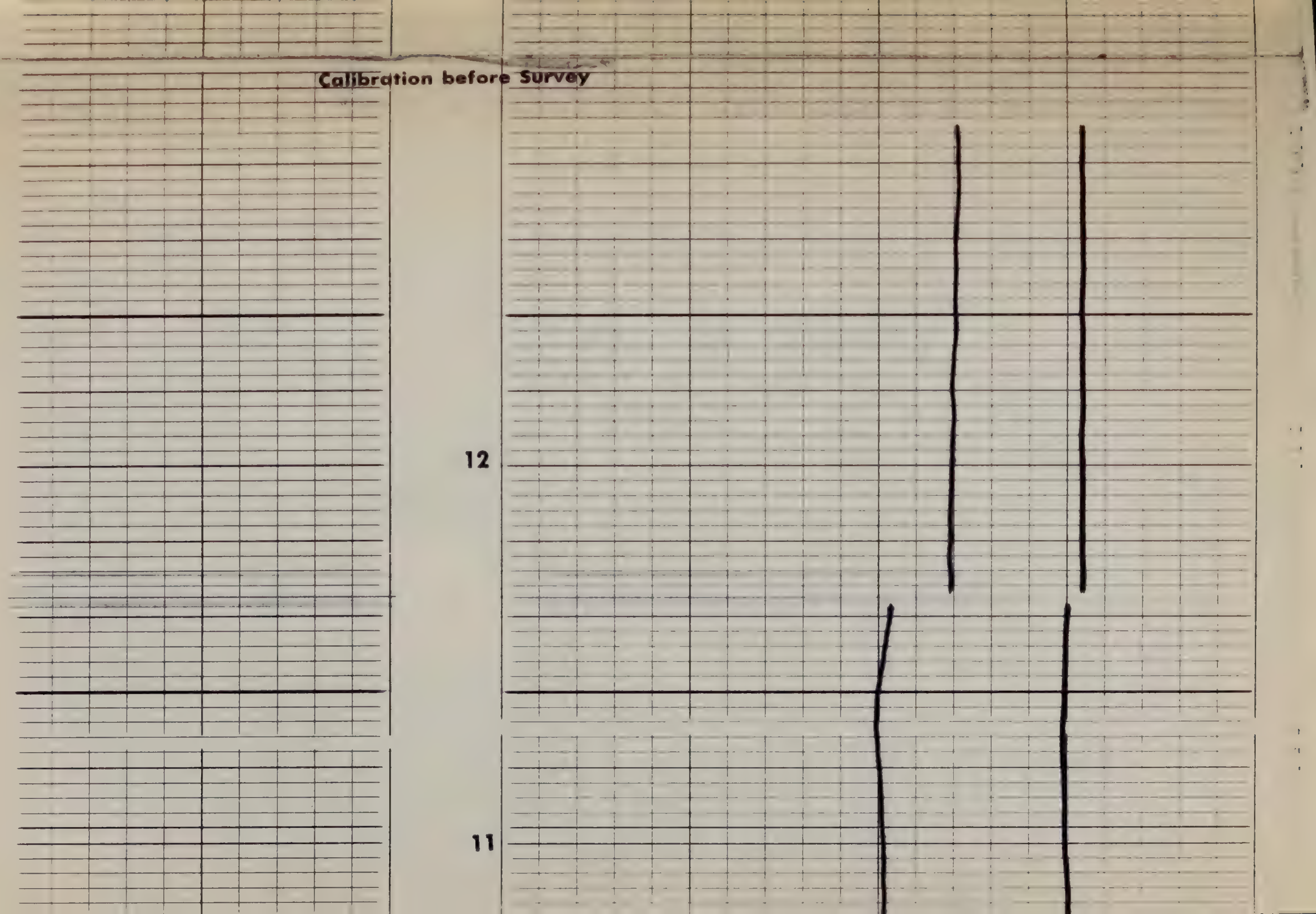
CALIBRATION RECORD

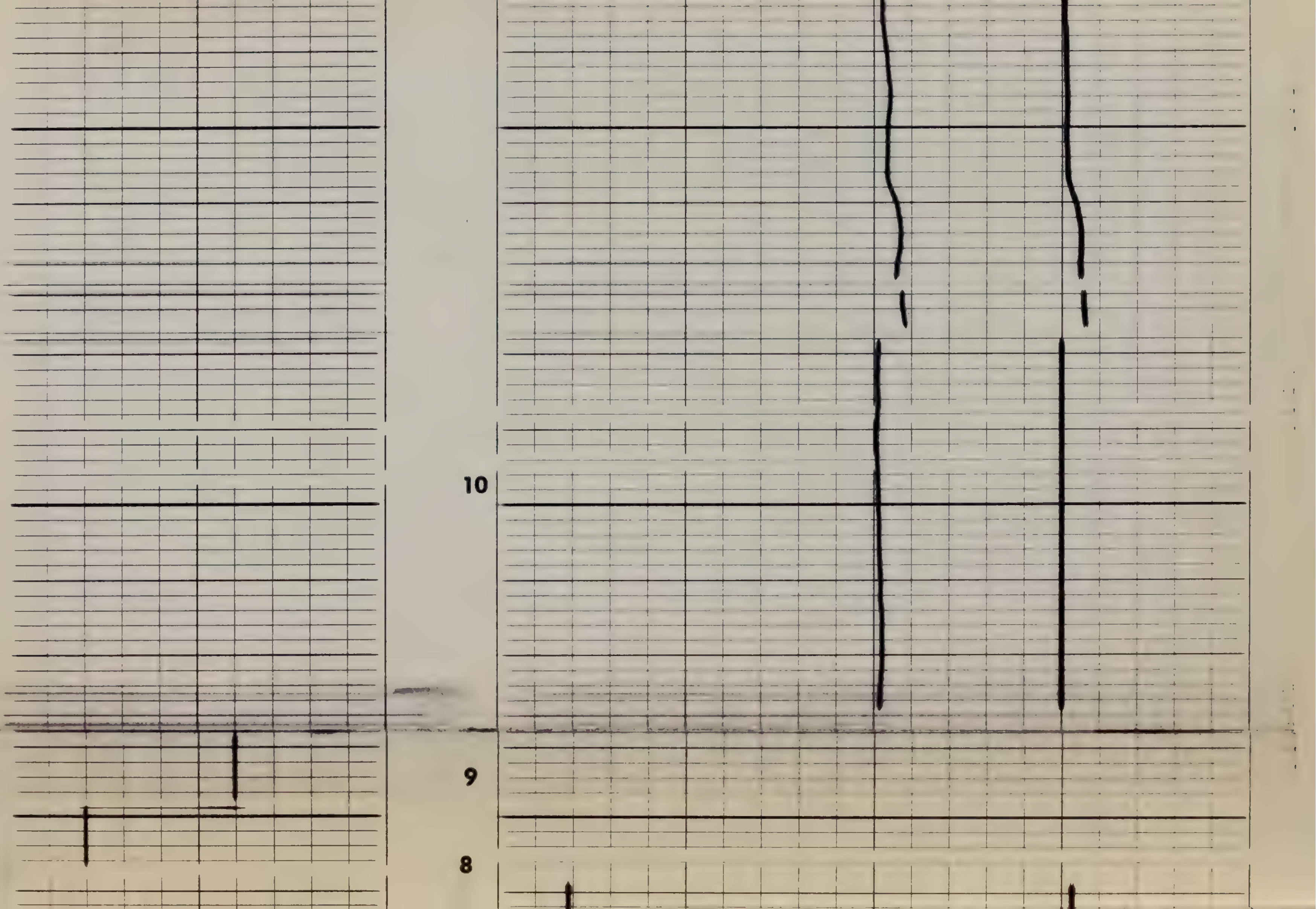


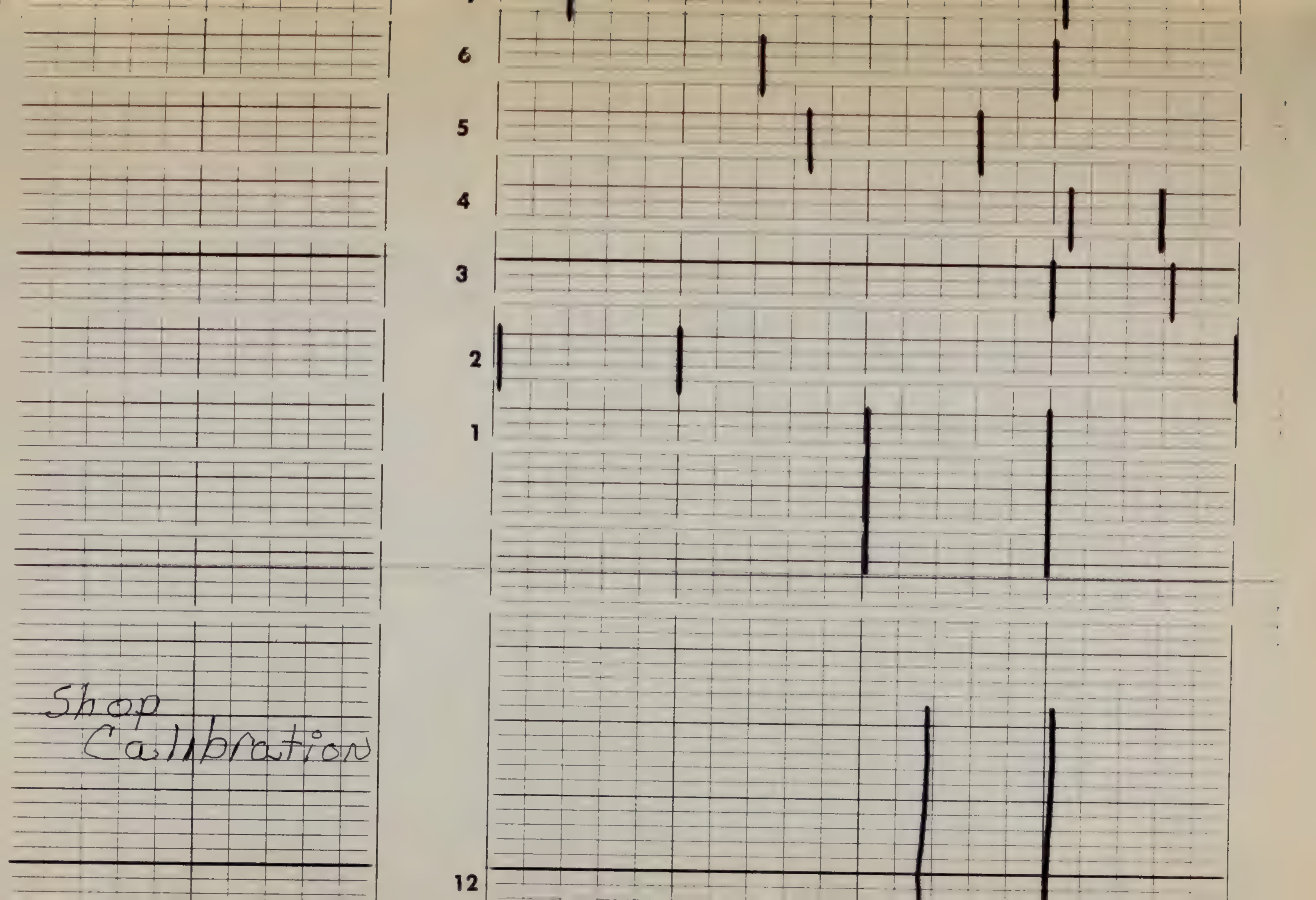

4
5
6

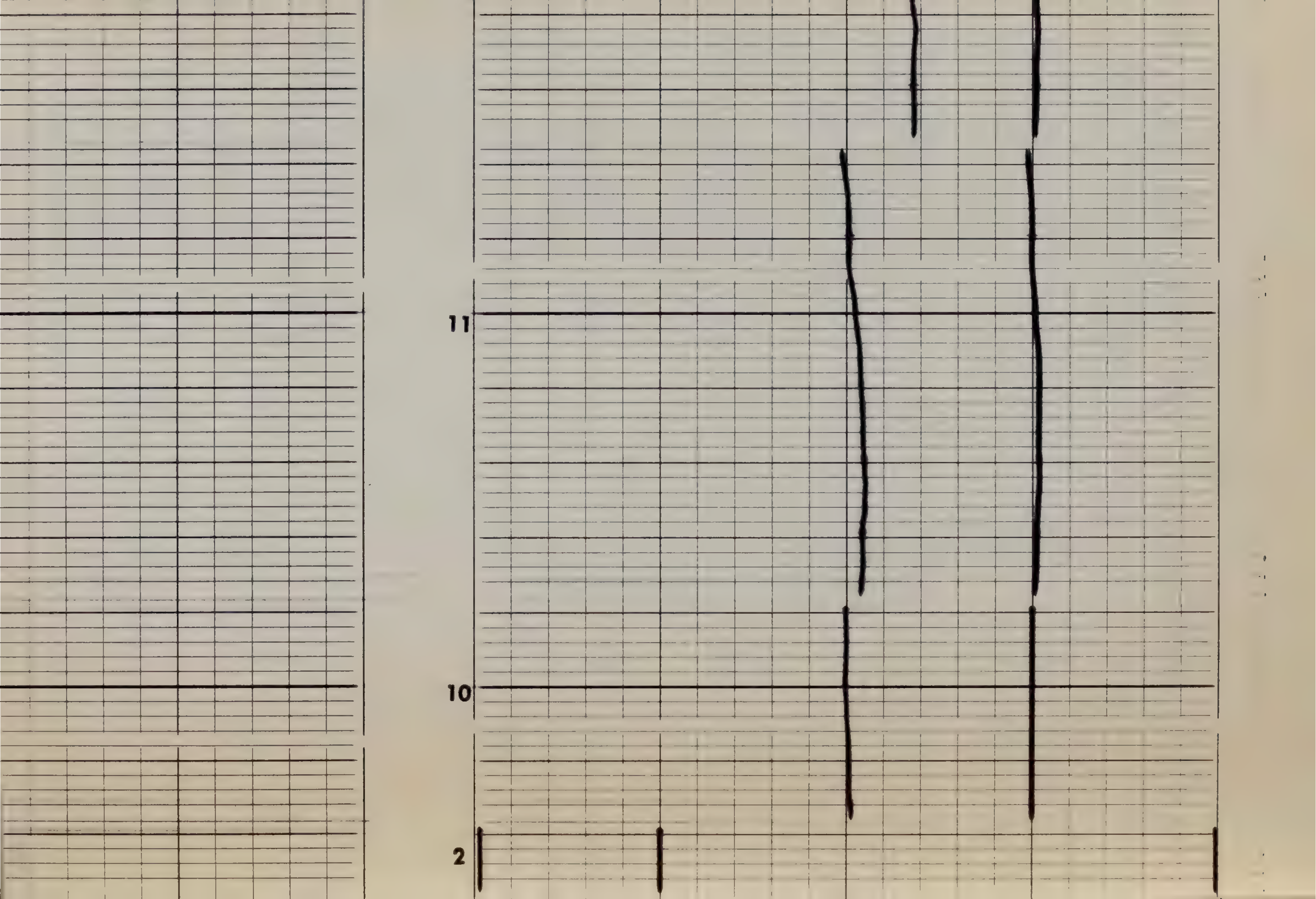

Calibration after Survey
12

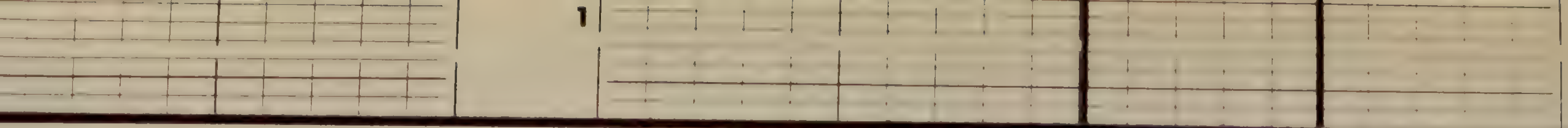

10
2
1


Calibration before Survey
12
11


10
9
8


6
5
4
3
2
1
12
Shop
Calibration


11
10
2



FORMATION DENSITY COMPENSATED CALIBRATION CODING

1. MECHANICAL ZERO
2. RECORDER SENSITIVITY

PANEL TEST

FDC LIQUID

	POS	ρ	$\Delta\rho$
3.	# 1	2.92	.00
4.	# 2	2.78	+.14
5.	# 3	2.42	−.10
6.	# 4	2.35	.00
7.	# 5	2.08	.01

8. MECHANICAL ZERO CALIPER
9. 8″ RING
10. 12″ RING
11. TOOL CALIBRATE # 1 SET $\rho = 2.50$
12. TOOL CALIBRATE # 2 SET $\Delta\rho = .00$
13. LOG POSITION $\rho = 2.59$, $\Delta\rho = .015$

GAMMA RAY CALIBRATION CODING

1. MECHANICAL ZERO
2. ELECTRICAL ZERO
3. RECORDER SENSITIVITY
4. MEMORIZER ADJUSTMENT
5. BACKGROUND
6. CALIBRATE - SOURCE IN PLACE

CALIBRATION RECORD

COMPANY THE ATLANTIC RICHFIELD COMPANY

WELL AQUIFER TEST NO. 1-B

FIELD ----

COUNTY RIO BLANCO STATE COLORADO

SCHL. FR 1640
SCHL. TD 1641
DRLR TD 1638
Elev:
KB ----
DF ----
GL 6909

Schlumberger

BOREHOLE COMPENSATED SONIC LOG

COUNTY RIO BLANCO
FIELD or LOCATION ----
WELL AQUIFER TEST NO. 1-B
COMPANY ATLANTIC RICHFIELD

COMPANY THE ATLANTIC RICHFIELD COMPANY

WELL AQUIFER TEST NO. 1-B

FIELD ----

COUNTY RIO BLANCO STATE COLORADO

LOCATION: API Serial No. 01036

Sec. 7 Twp. 3S Rge. 96W

Other Services:
DIL ENG. PRO.
FDC-GR
CNL-GR

Permanent Datum: GL ; Elev.: 6909
Log Measured From GL , 0 Ft. Above Perm. Datum
Drilling Measured From GL

Elev.: K.B. ----
D.F. ----
G.L. 6909

Date	7-21-74			
Run No.	ONE			
Depth—Driller	1638			
Depth—Logger	1642			
Btm. Log Interval	1640			
Top Log Interval	410			
Casing—Driller	8-5/8@ 60	@	@	@
Casing—Logger	72			
Bit Size	7-7/8			
Type Fluid in Hole	WATER			
Dens. | Visc.	410			
pH | Fluid Loss	8.3 ml	ml	ml	ml
Source of Sample				
R_m @ Meas. Temp.	@ °F	@ °F	@ °F	@ °F
R_{mf} @ Meas. Temp.	@ °F	@ °F	@ °F	@ °F
R_{mc} @ Meas. Temp.	@ °F	@ °F	@ °F	@ °F
Source: R_{mf} | R_{mc}				
R_m @ BHT	@ °F	@ °F	@ °F	@
TIME Circulation Stopped				
TIME	24 HRS.			
Max. Rec. Temp.	90 °F	°F	°F	°F
Equip. | Location	5602 | G.J.			
Recorded By	SCHNORR			
Witnessed By	TAIT			

Run No.	ONE			
Service Order No.	01036			
Fluid Level				

EQUIPMENT DATA

Sonic Panel No.	JD-439			
Sonic Cart No.	A-166			
Sonic Sonde No.	D-499			
Mem. Panel No.	B-260			
G.R. Cart. No.	----			
G.R. Panel No.	----			
Caliper No.	VCD-D-851			
TTR No.	----			
Centralizers: No.	CALIPERMRUBBER STANDOFF & SPRING			
Type				
Standoffs: No.	1-1/2"			
Type				
Time Const.-Sec.	----			
Speed - F.P.M.	----			

CALIBRATION DATA

GR	BKG. CPS	----			
	Source CPS	----			
	Tc Sec	----			

SCALE CHANGES

Type Log	Depth	Scale Up Hole	Scale Down Hole

LOGGING DATA

Porosity Selectors				Depth	
Δt_m	Δt_f	Cp	Ø Scale	From	To

REMARKS

$$\text{Velocity (ft/sec)} = \frac{1{,}000{,}000}{\text{Interval Transit Time (microseconds per foot)}}$$

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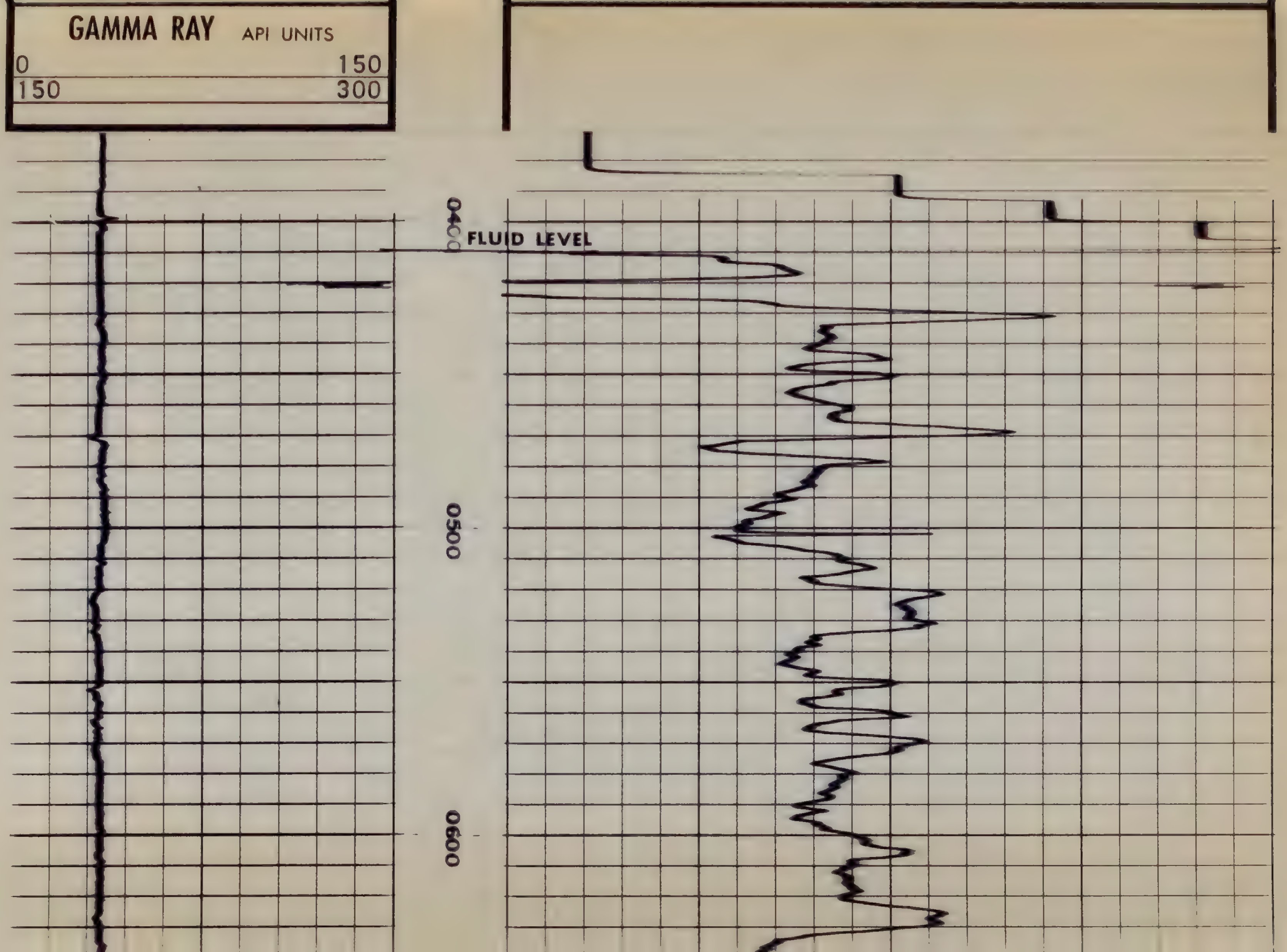
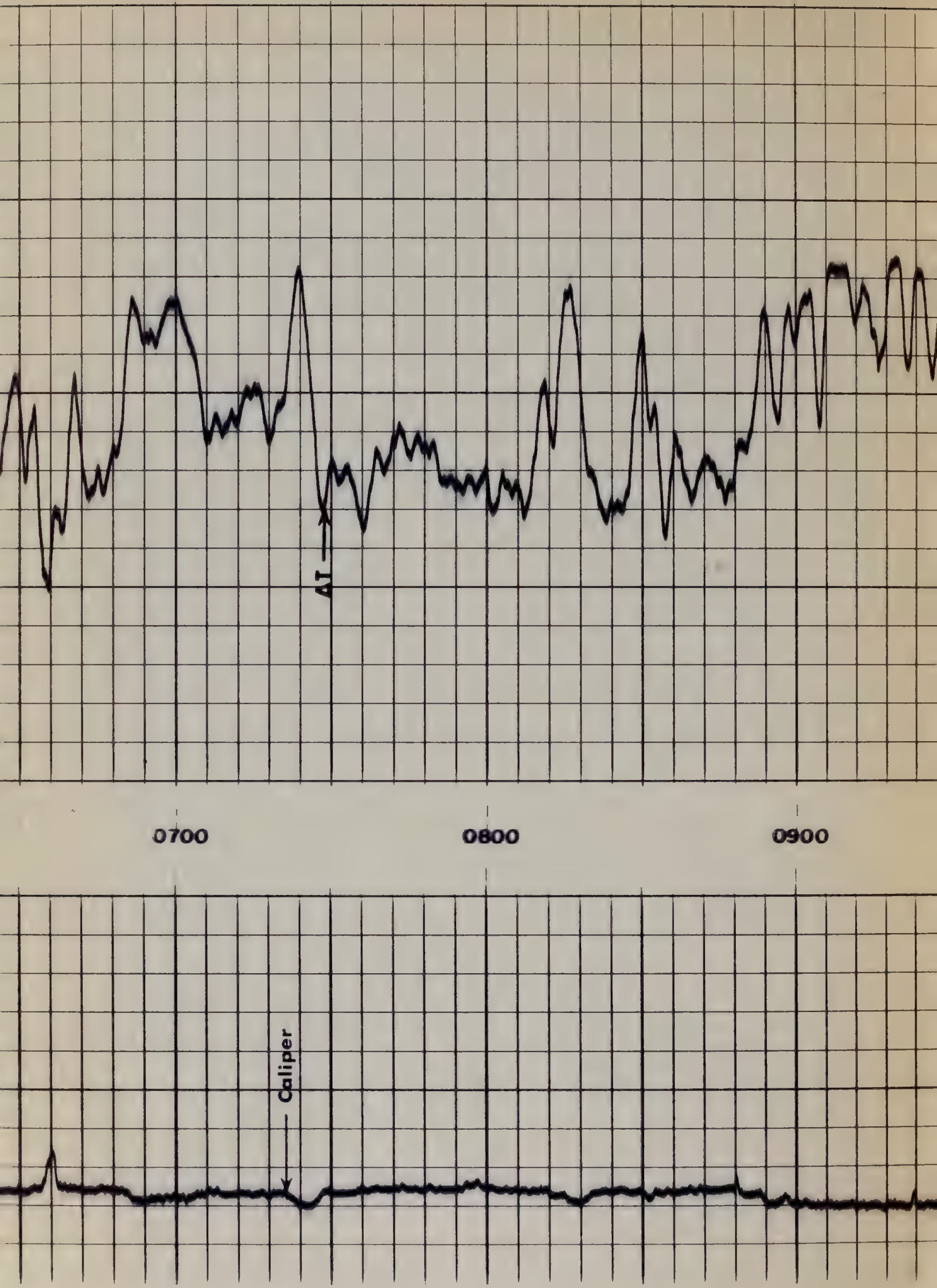
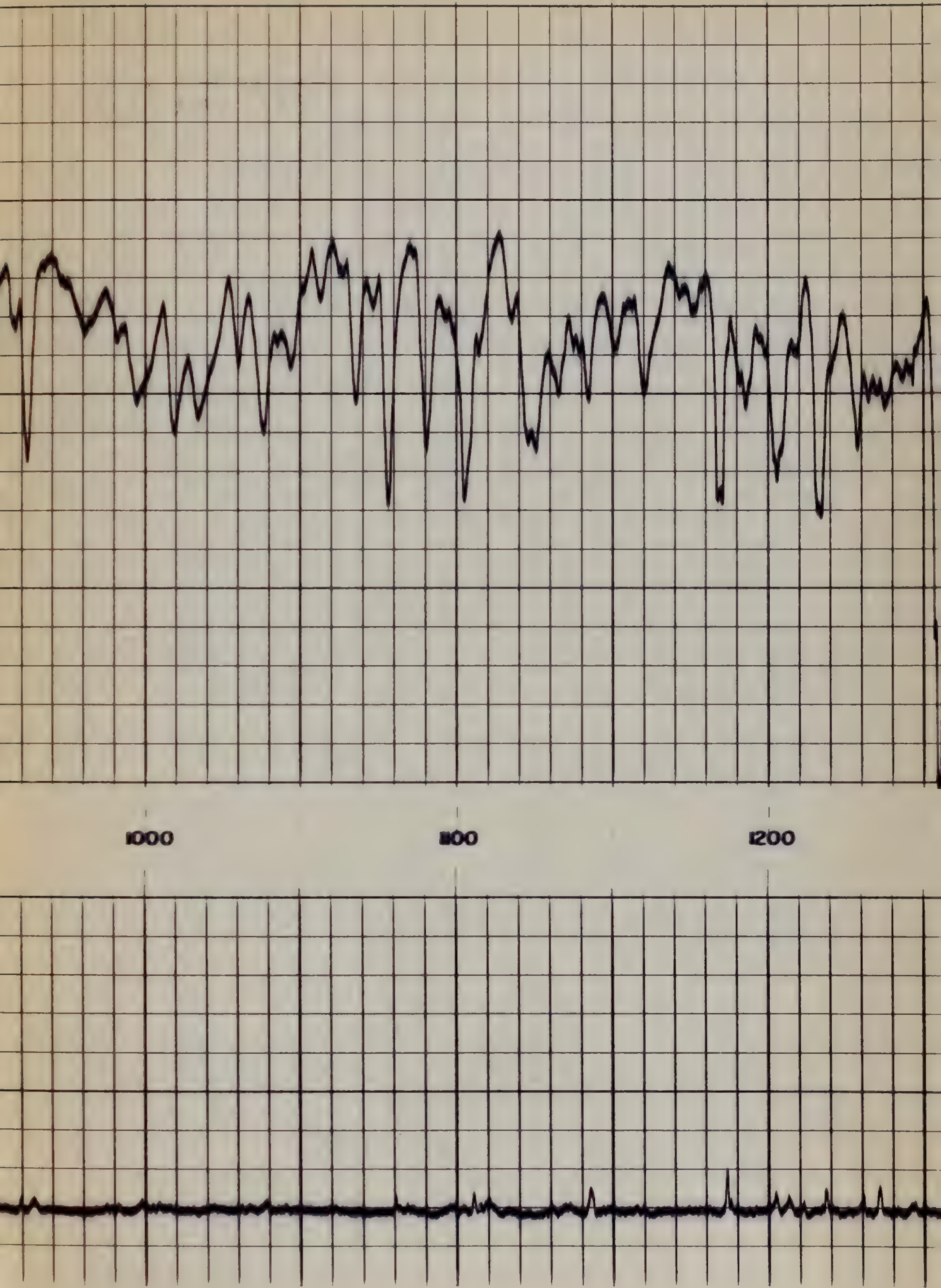
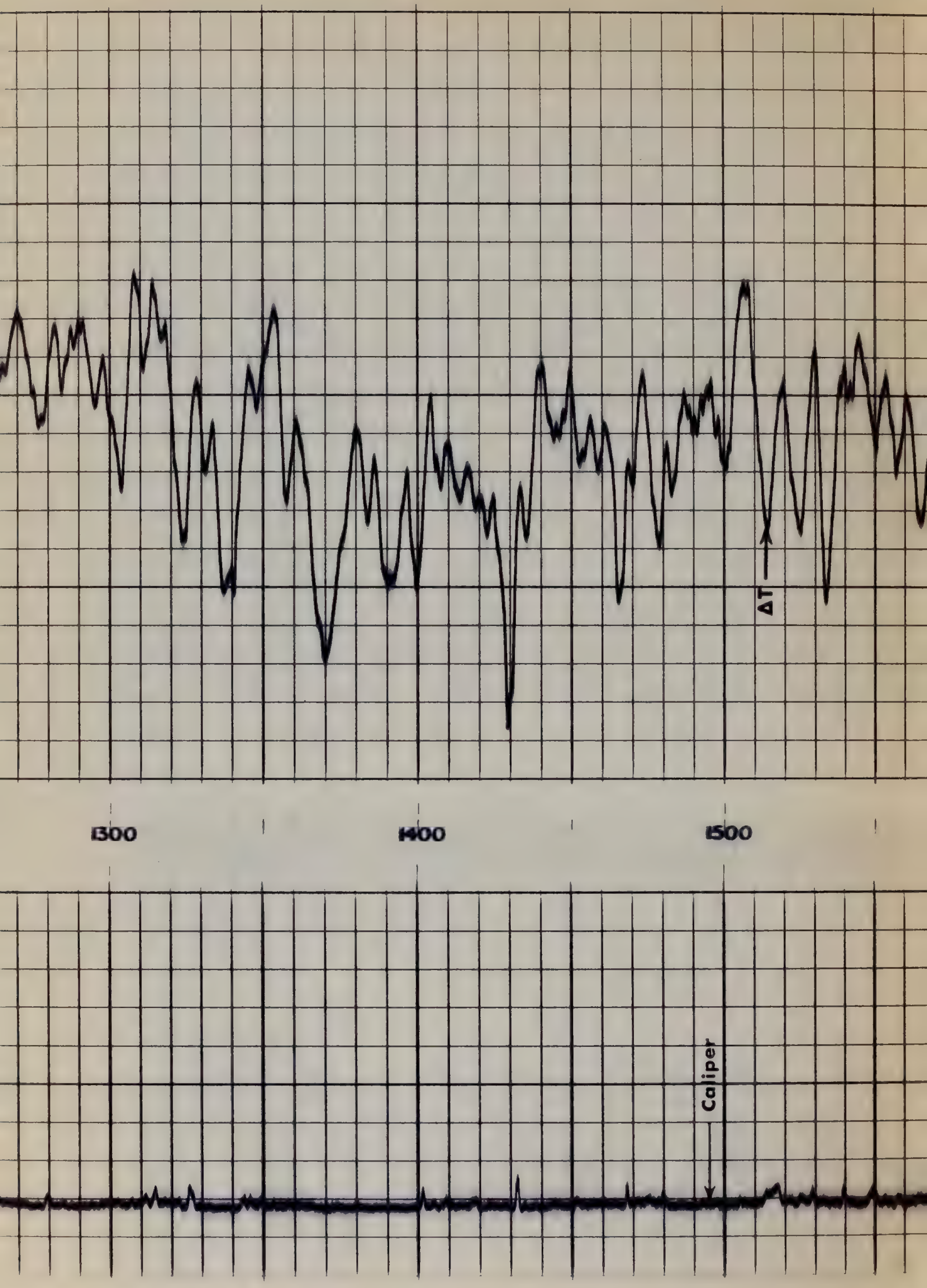
CALIPER DIAM. IN INCHES	DEPTH	INTERVAL TRANSIT TIME MICROSECONDS PER FOOT T 3 R₁ 2 R₂
6 … 16		150 … 100 … 50
		250 … 200 … 150


GAMMA RAY API UNITS
0
150
150
300
0400
FLUID LEVEL
0500
0600


AT
0700
0800
0900
Caliper



1000
1100
1200


ΔT
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1400
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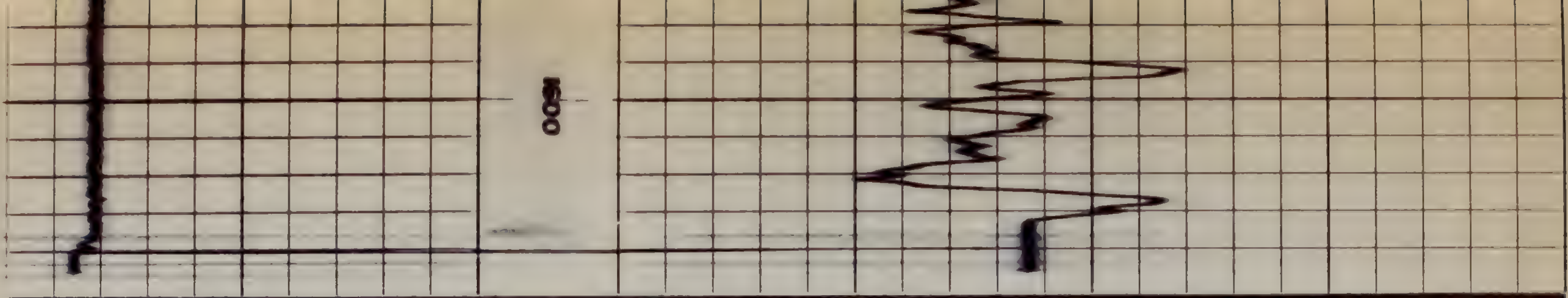
Caliper



DETAIL LOG

5″=100′

GAMMA RAY

API UNITS

0 150

150 300

DEPTHS

INTERVAL TRANSIT TIME

MICROSECONDS PER FOOT

150 $T\underline{\ 3\ }R_1\underline{\ 2\ }R_2$ 50

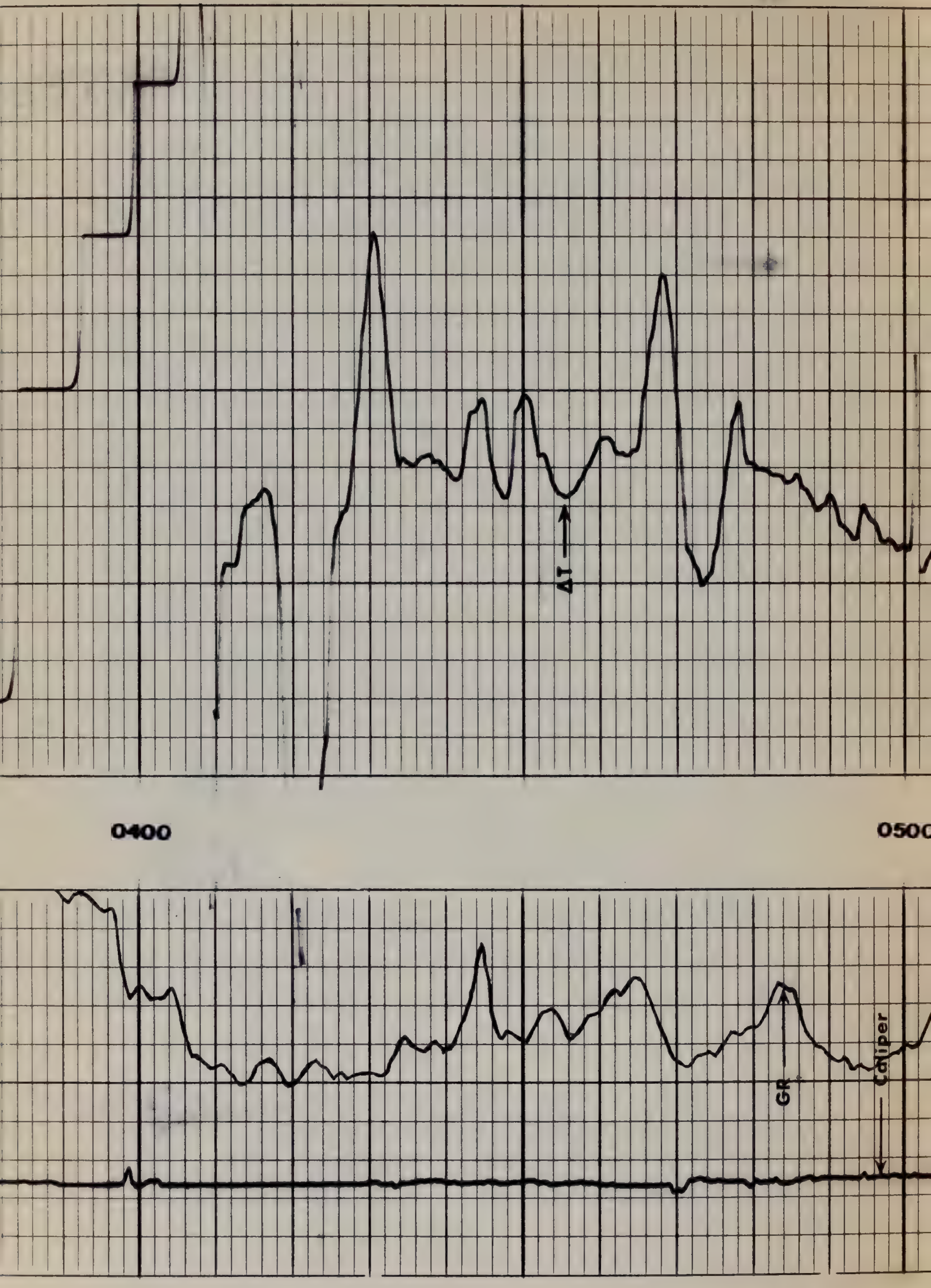
100

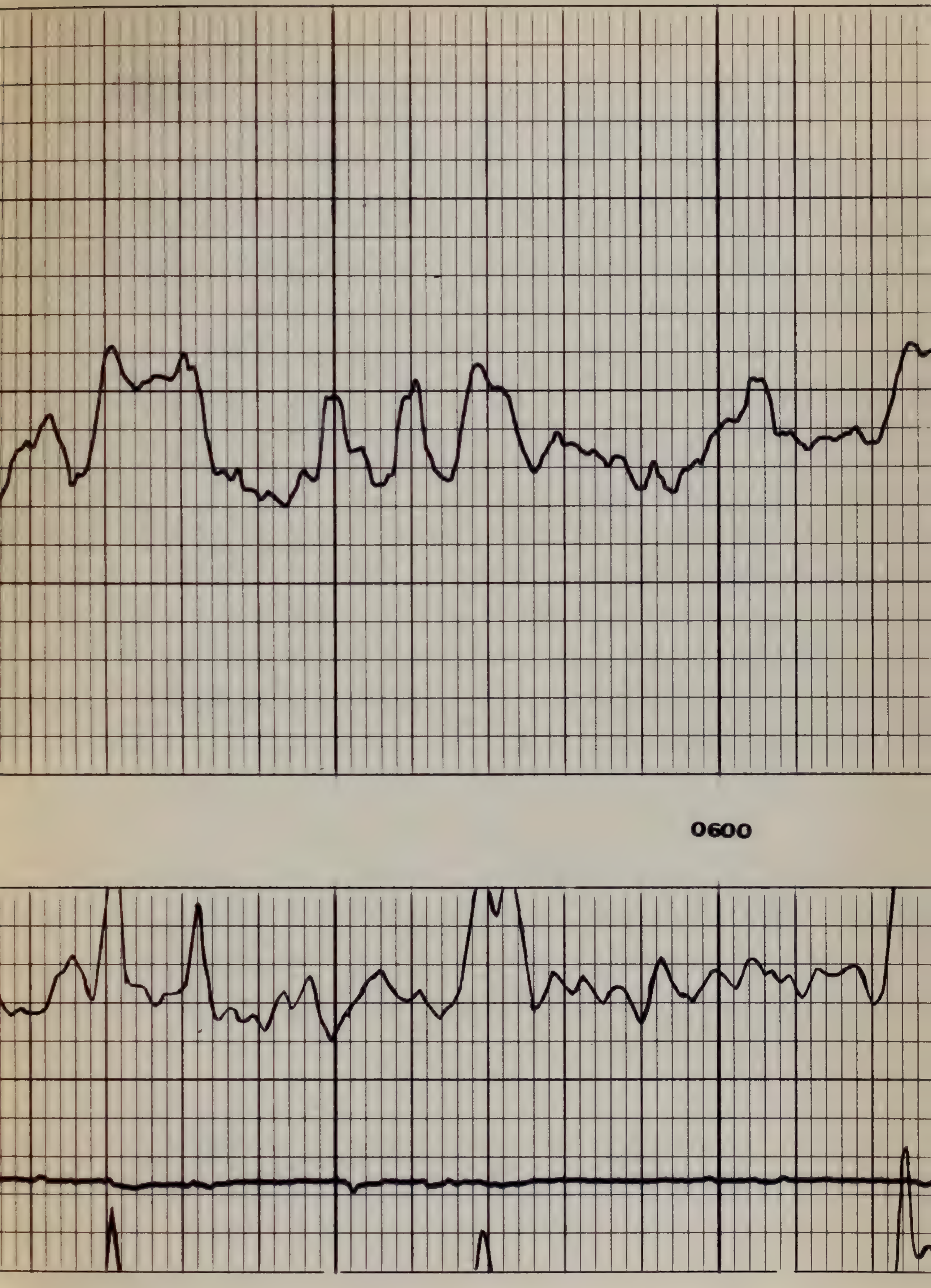
250 200 150

CALIPER

HOLE DIAM. IN INCHES

6 16


ΔT
0400
0500
GR
Caliper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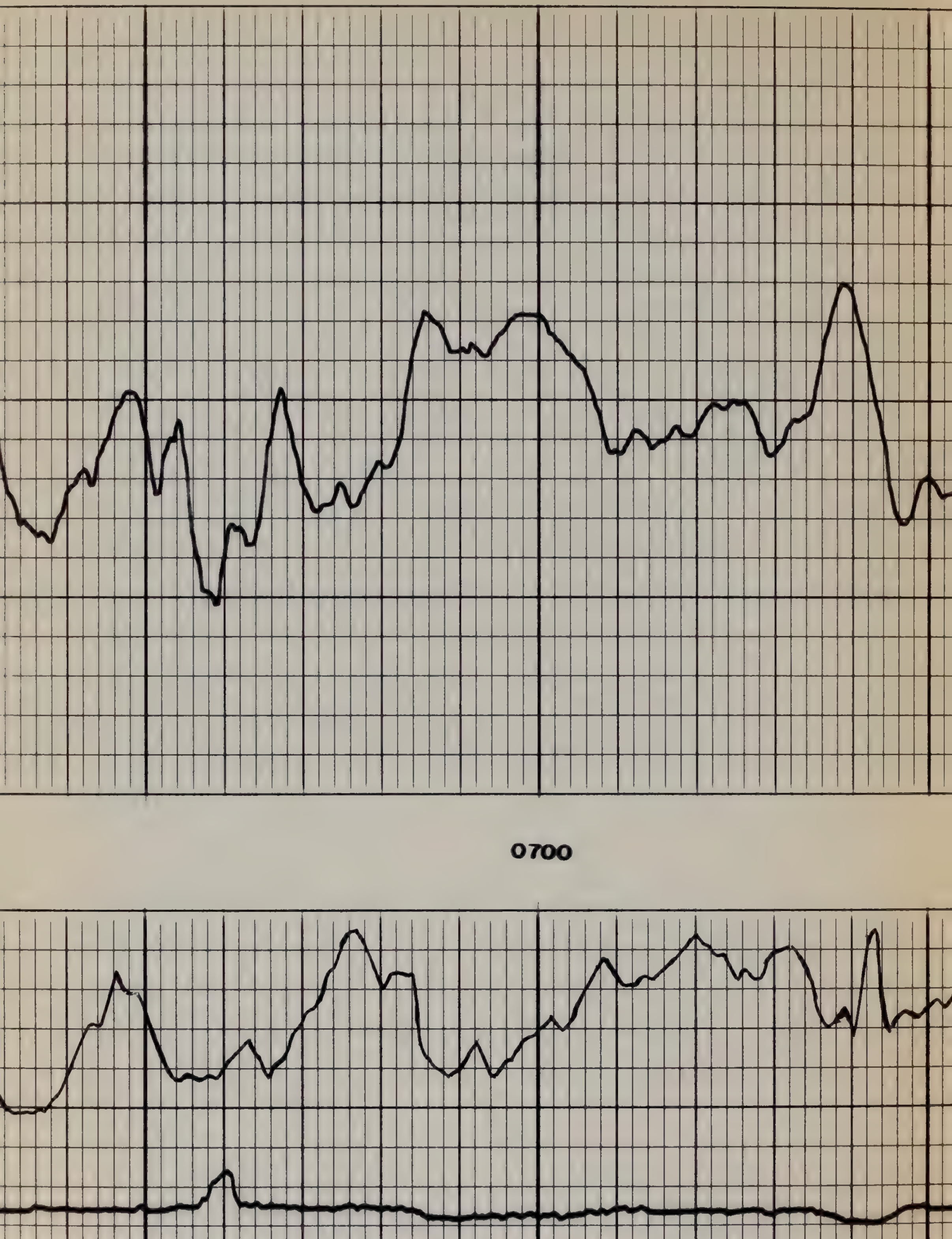
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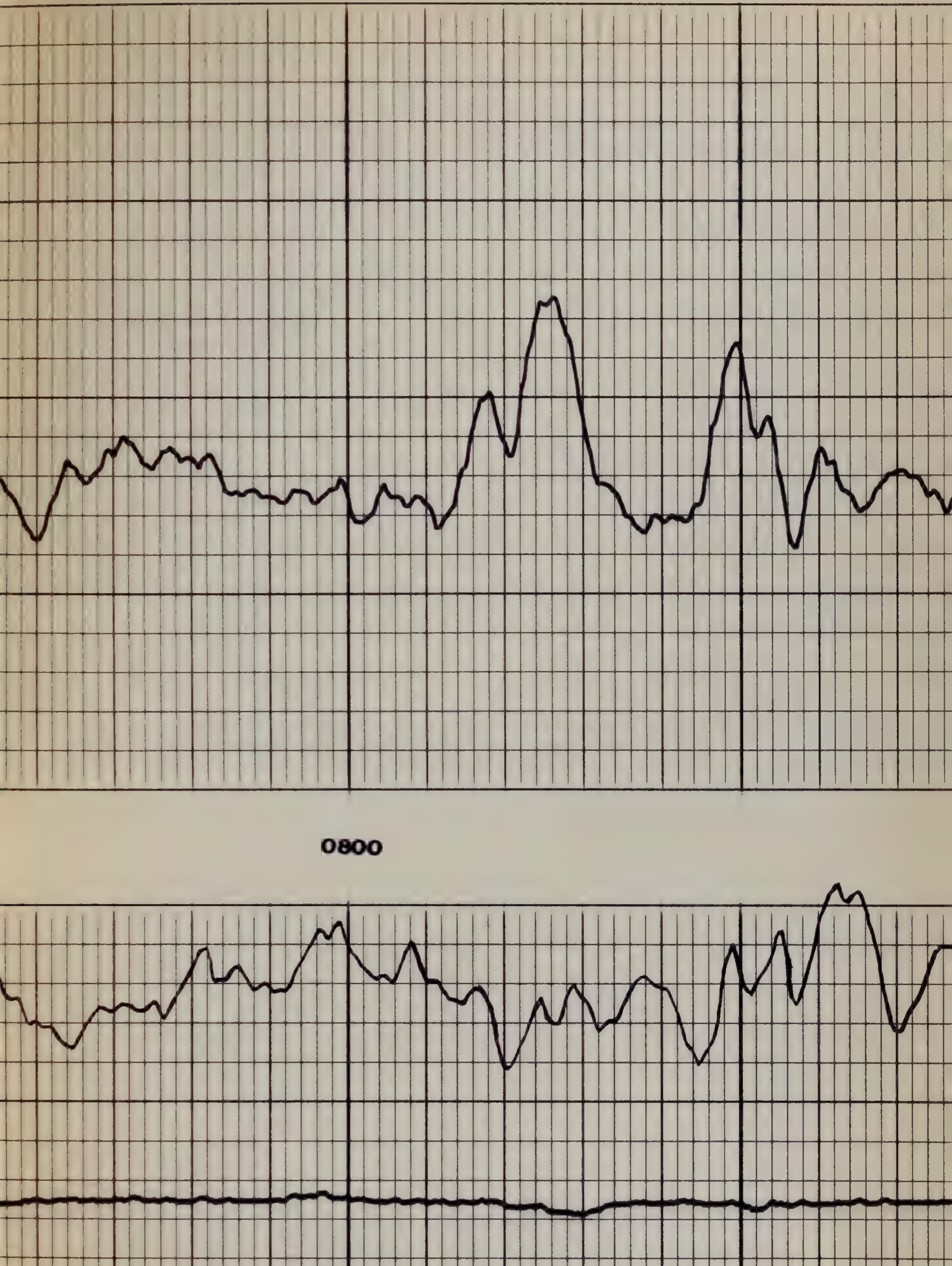
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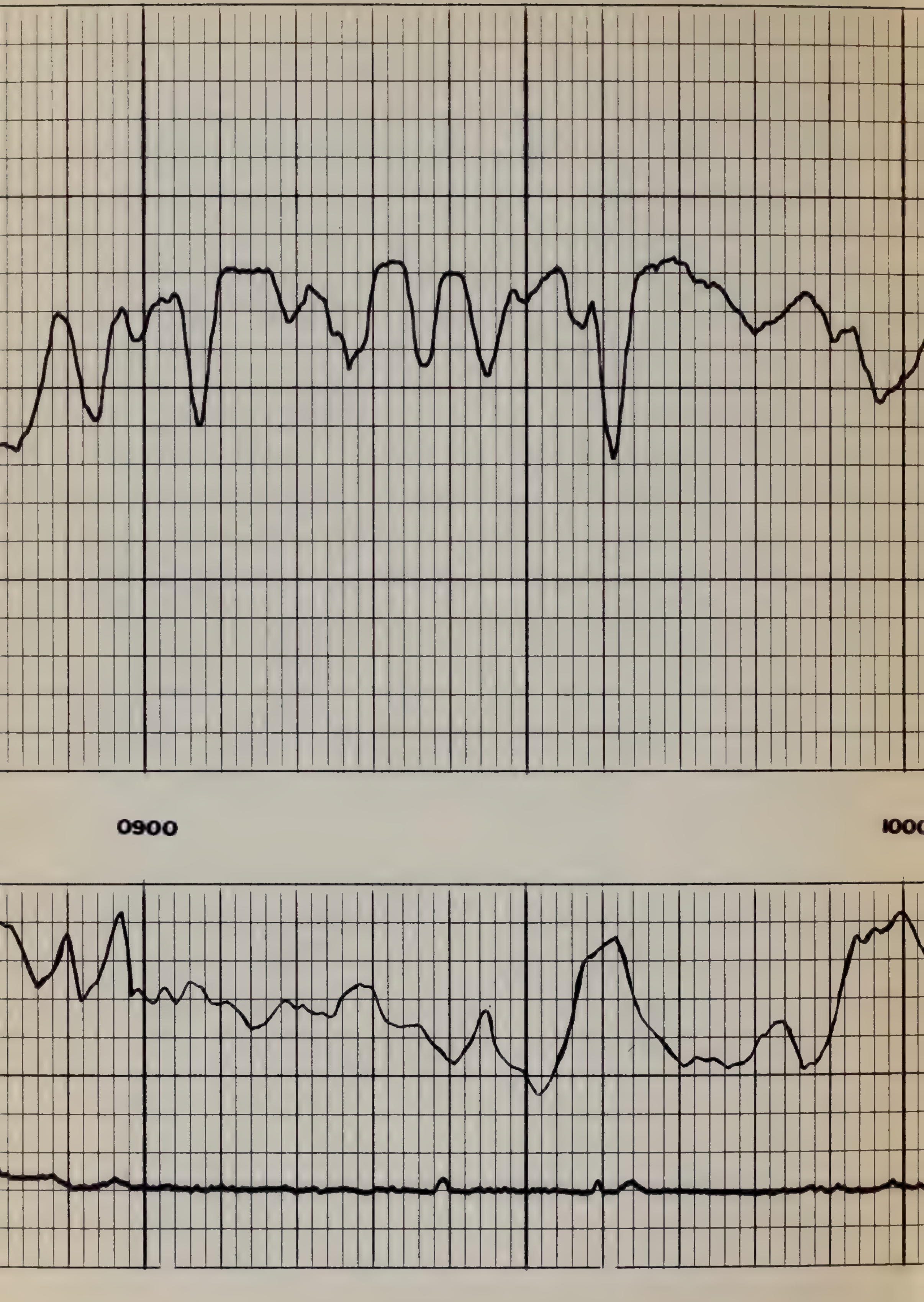
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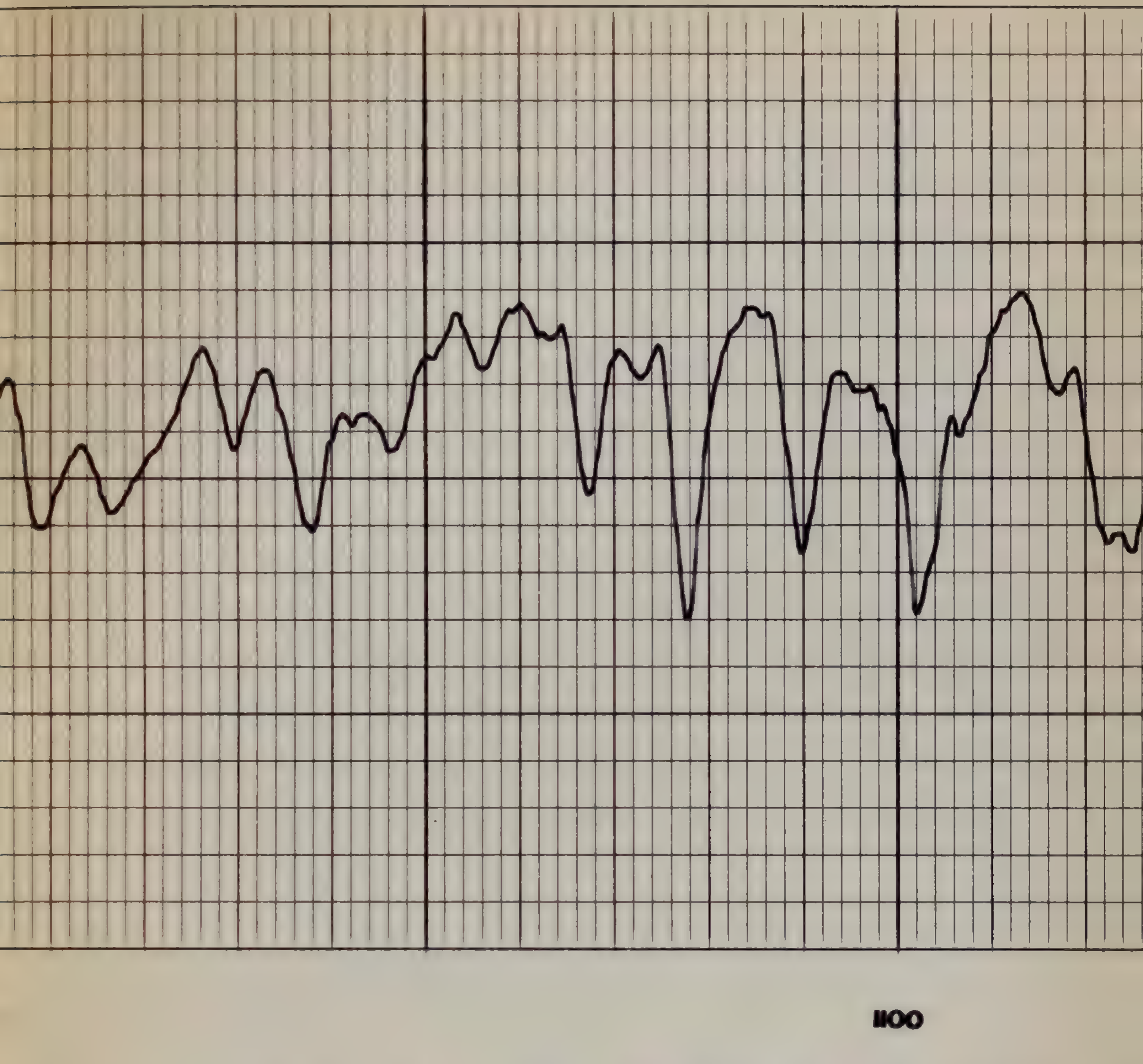
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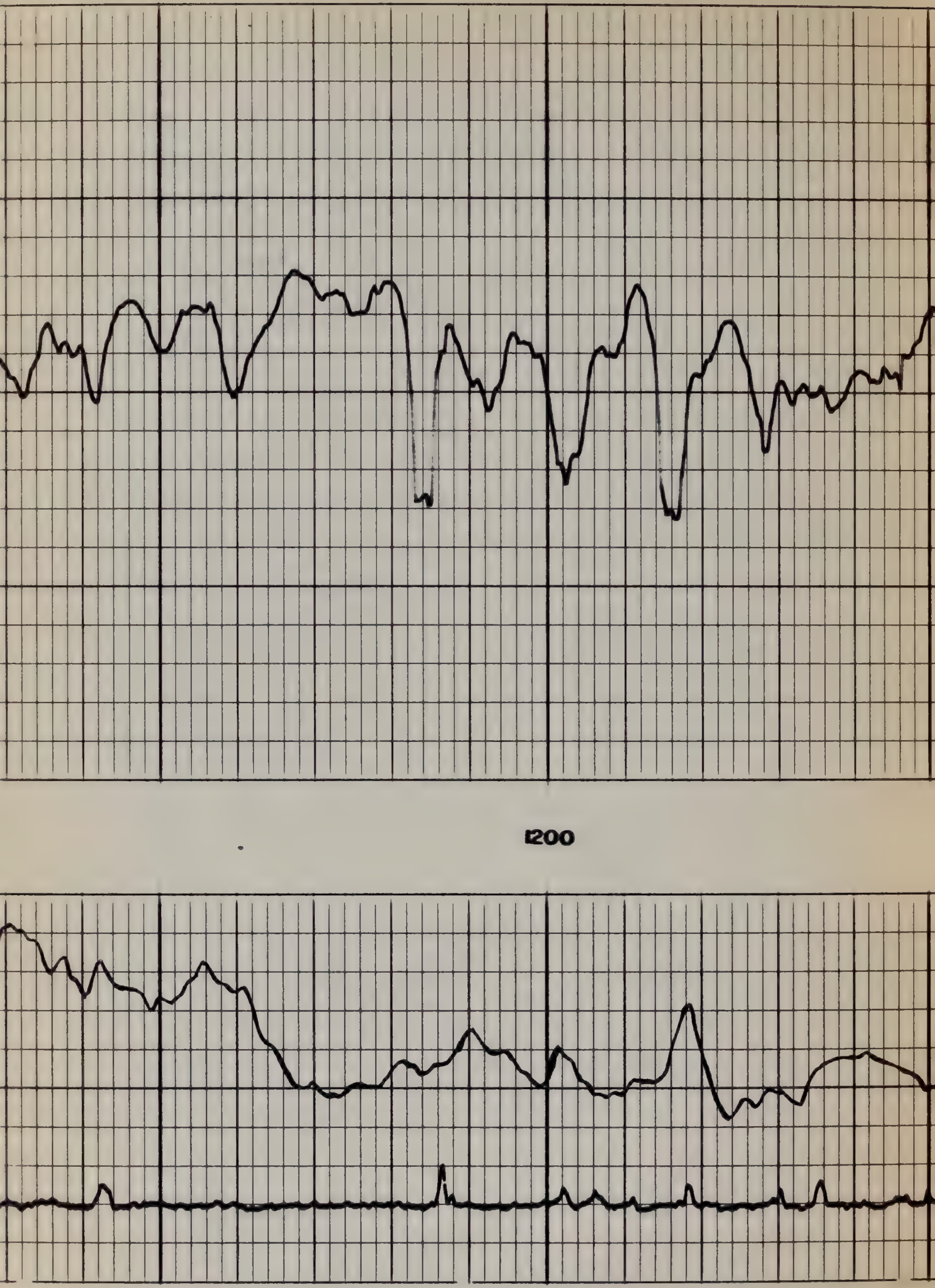
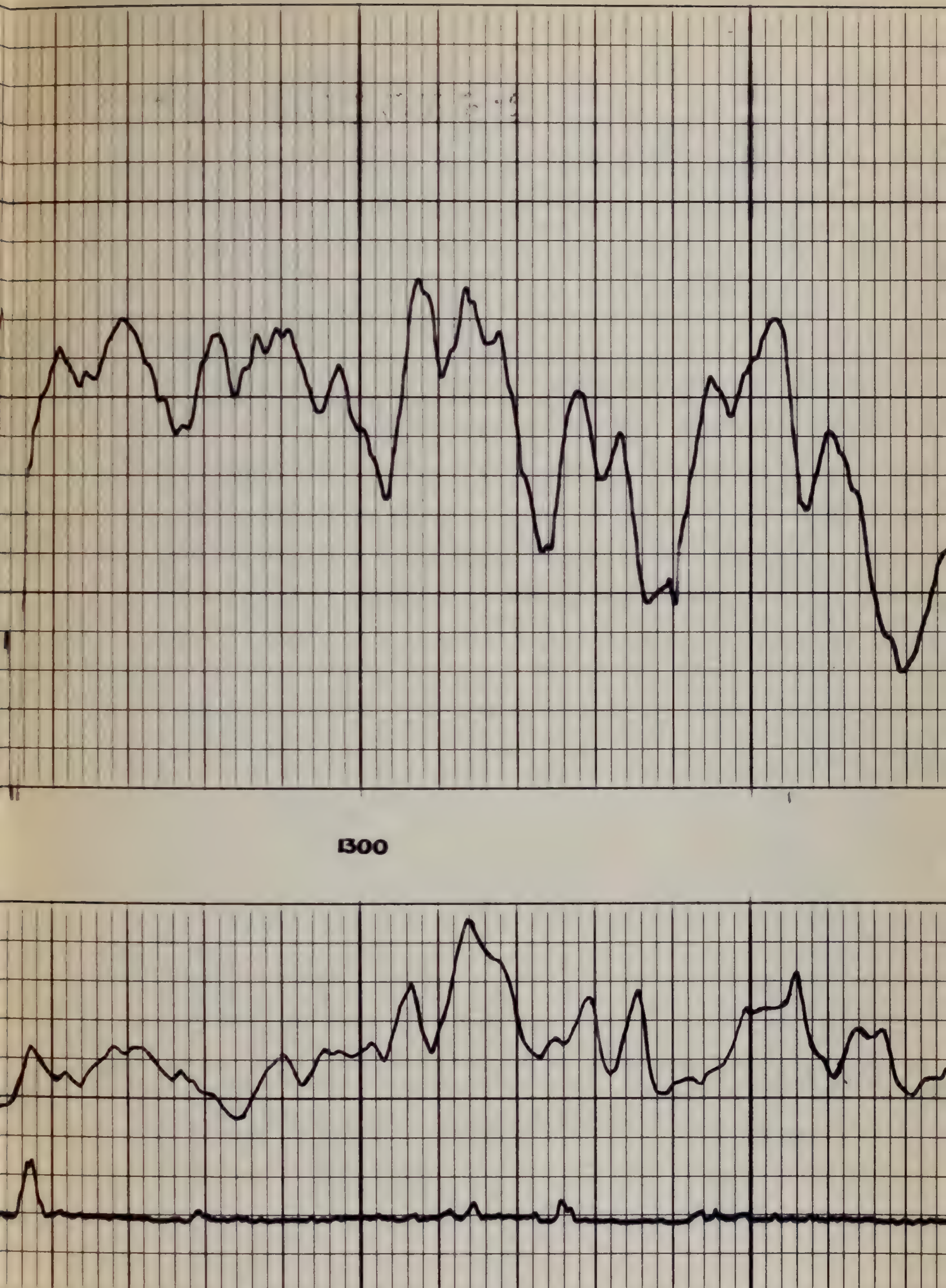
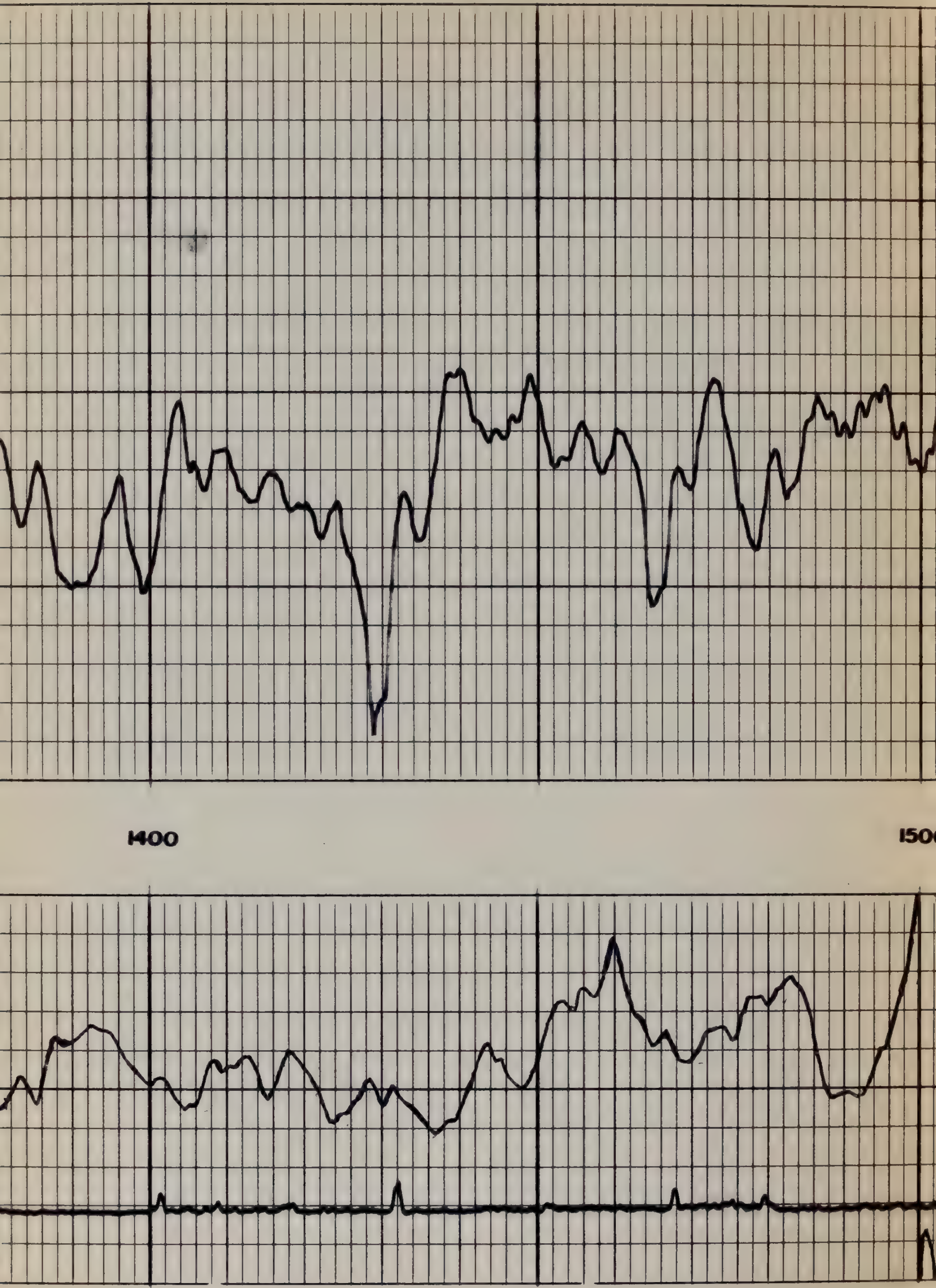
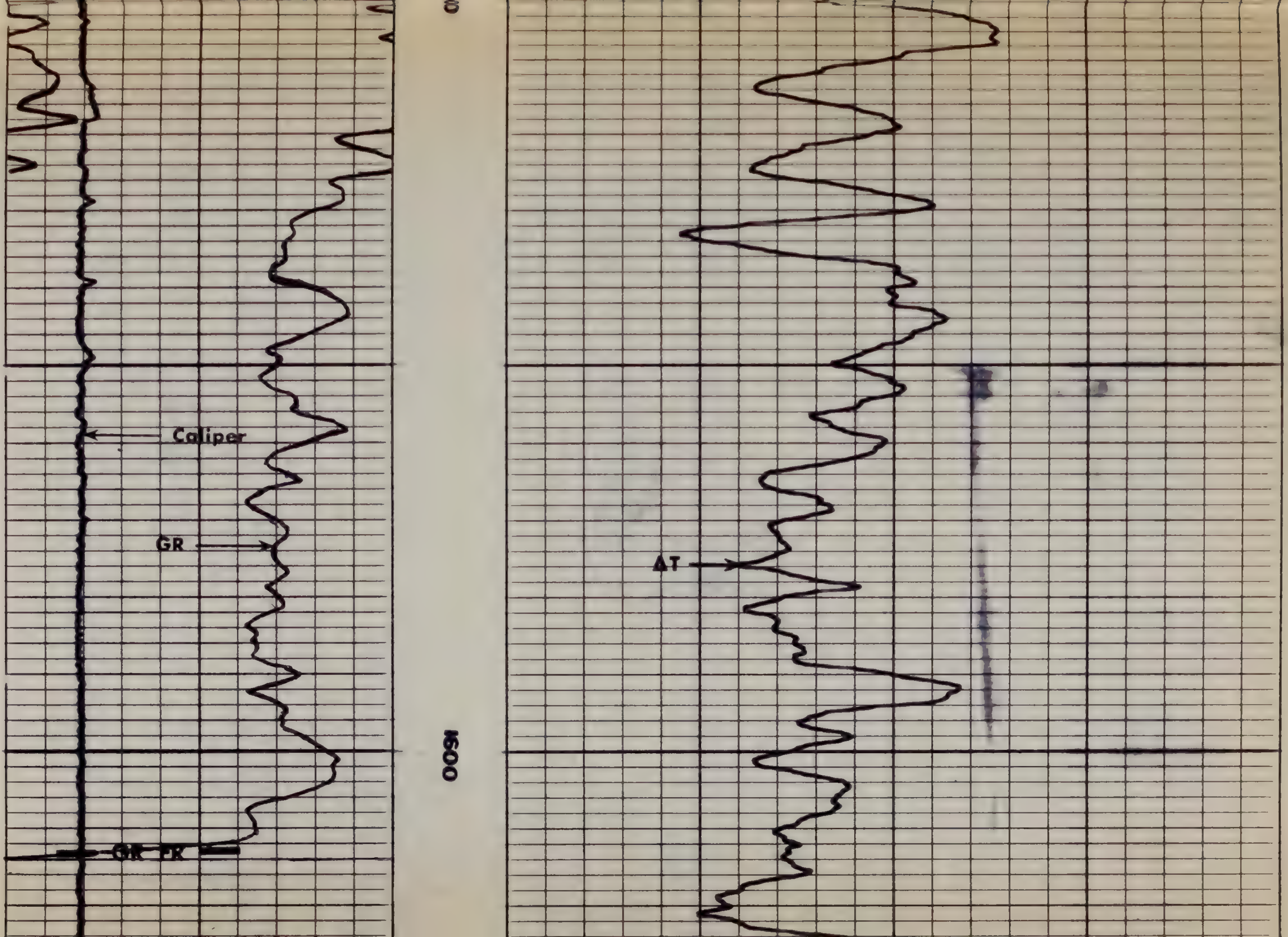
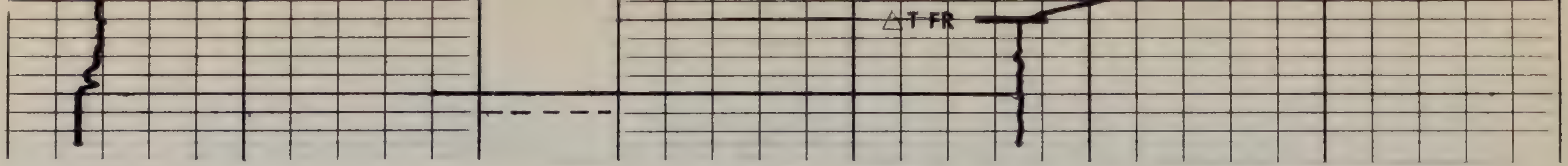
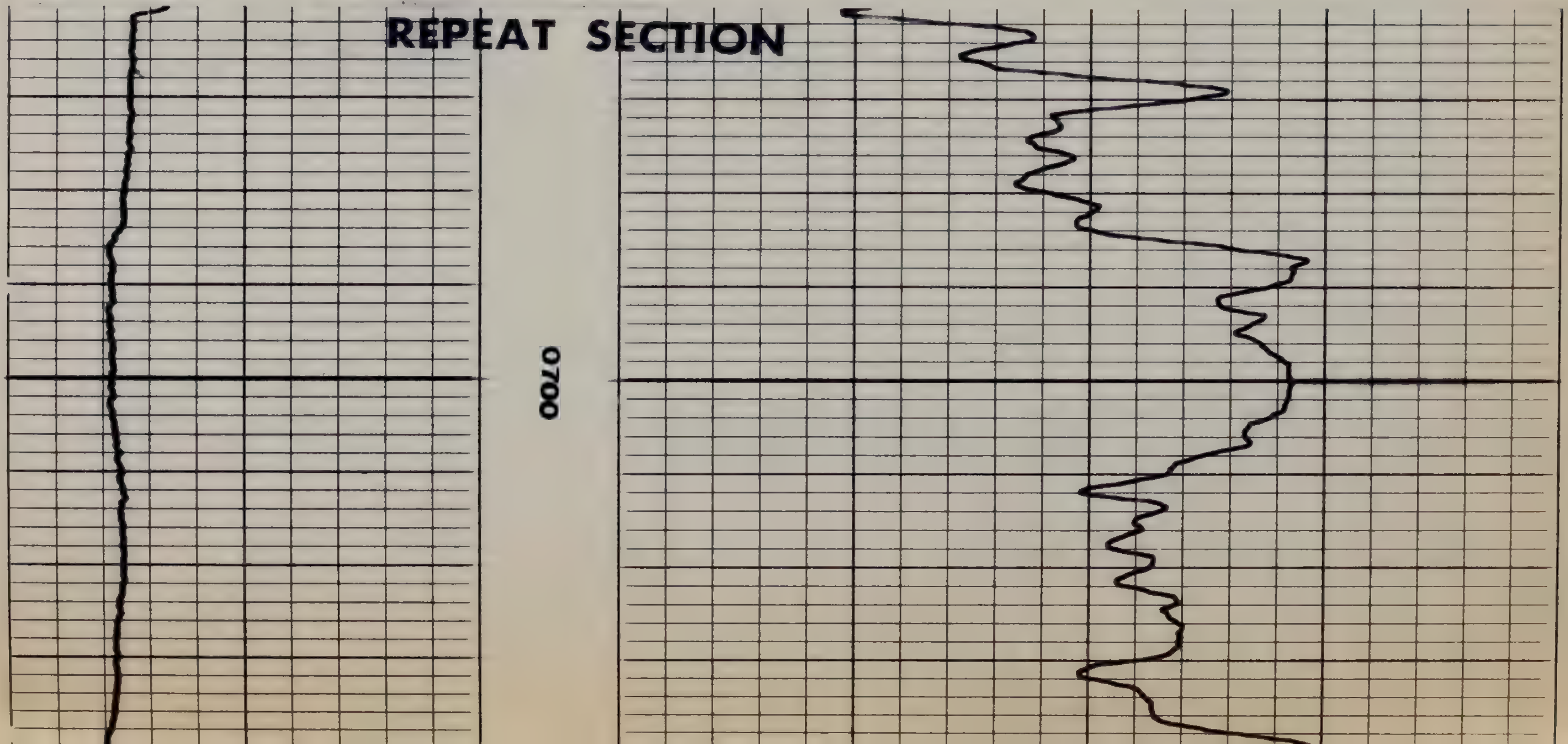

1200


1300


1400
150


Caliper
GR
GR FR
1600
ΔT


ΔT-FR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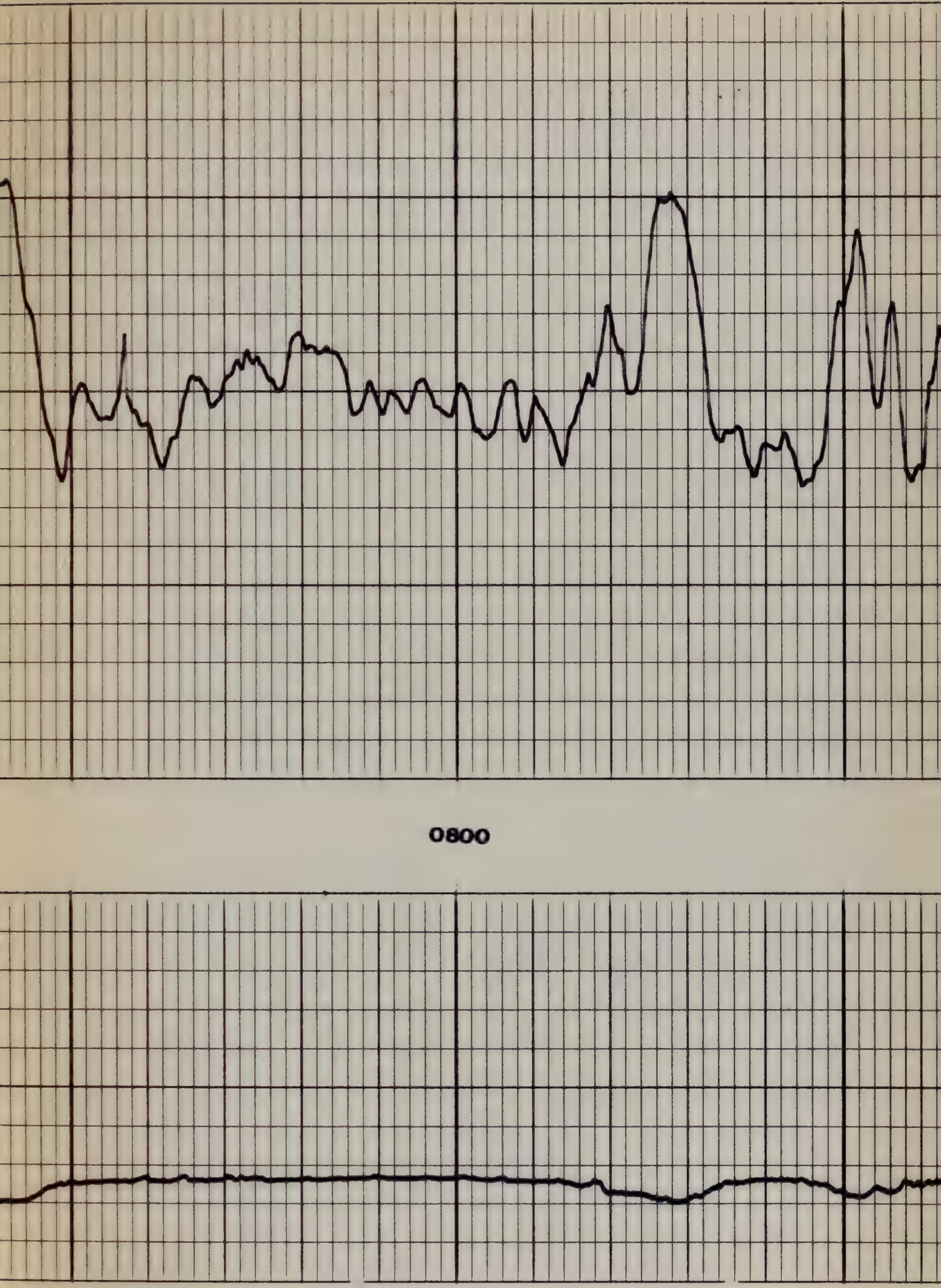
0700



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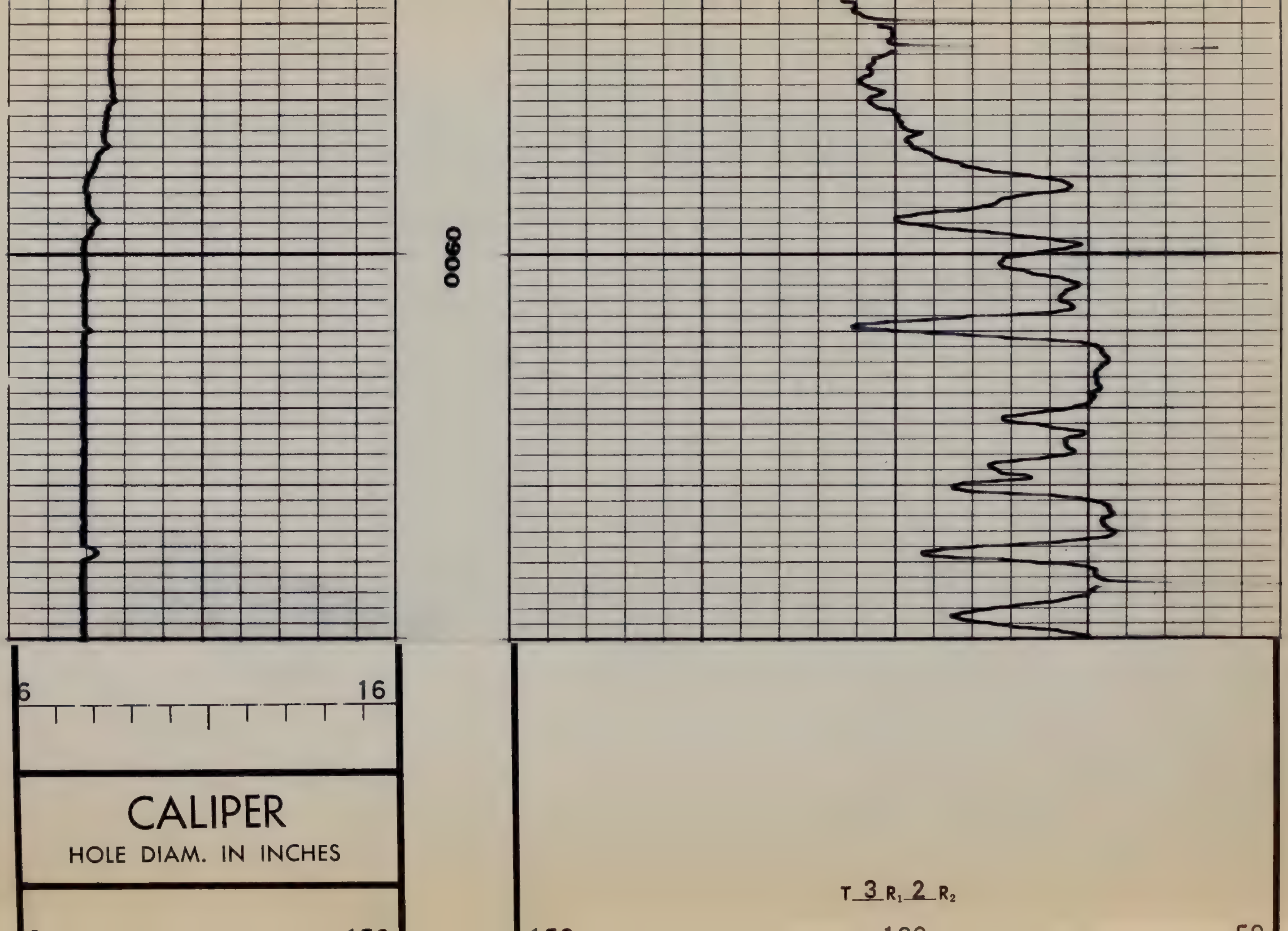
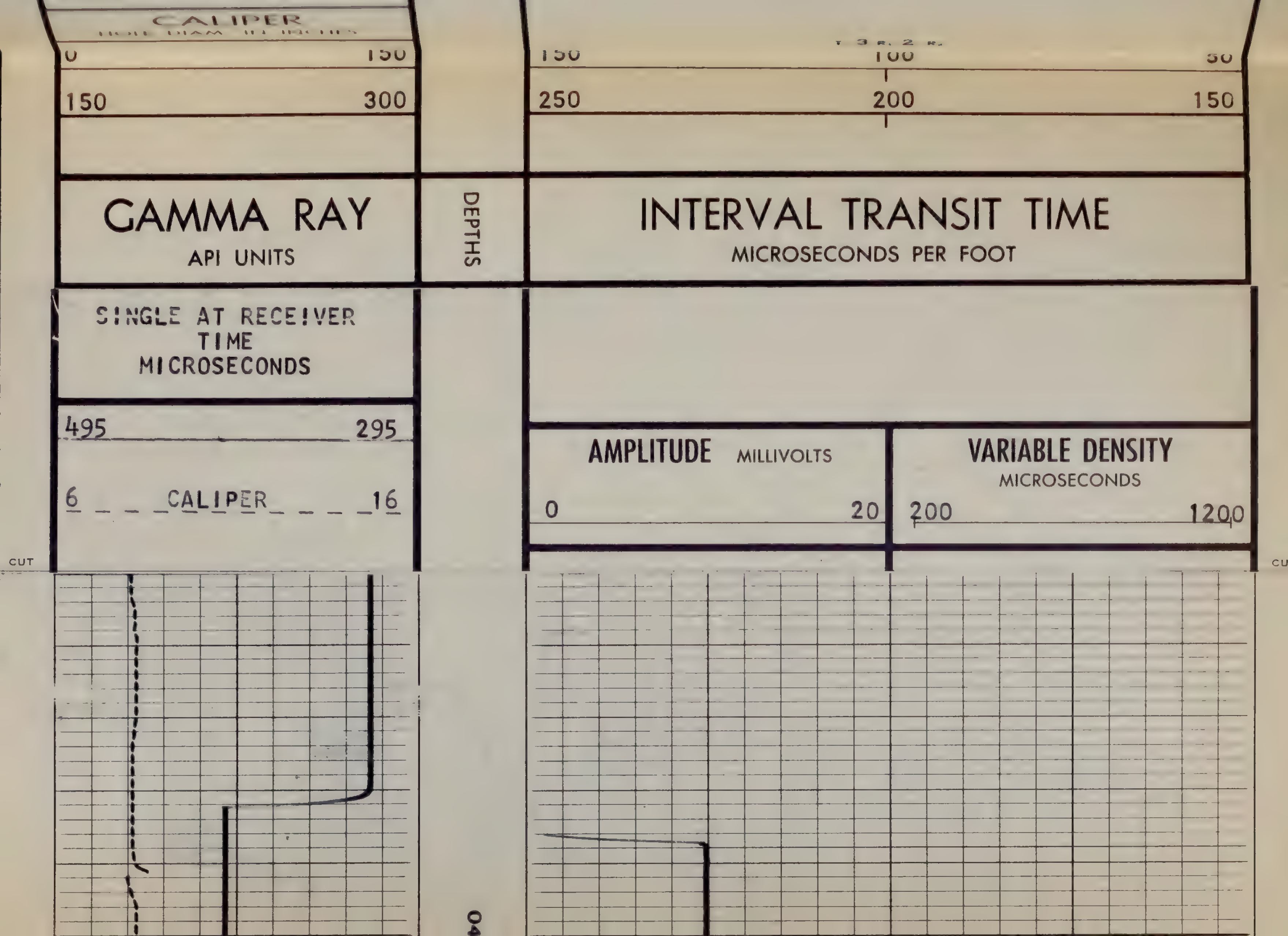
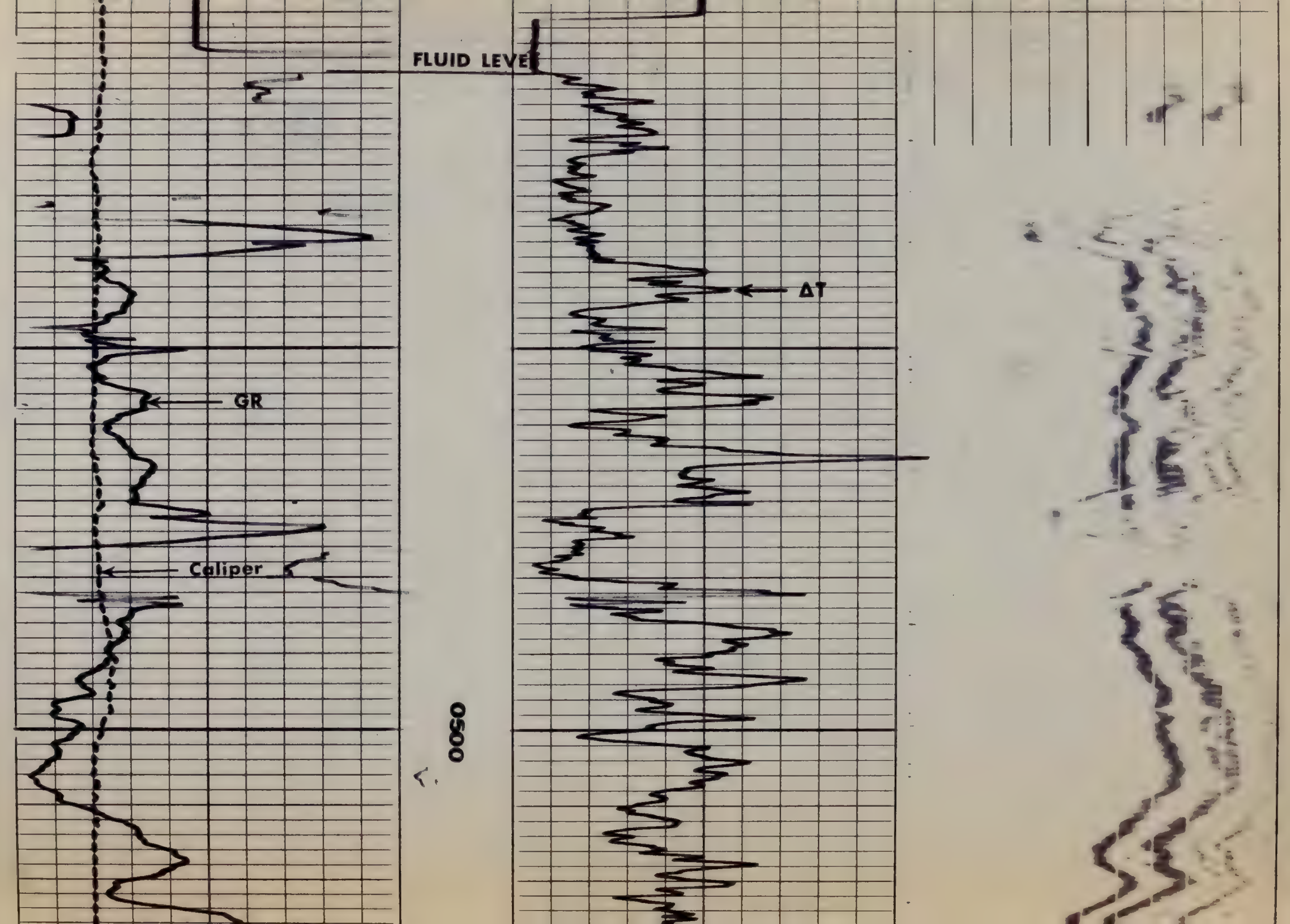
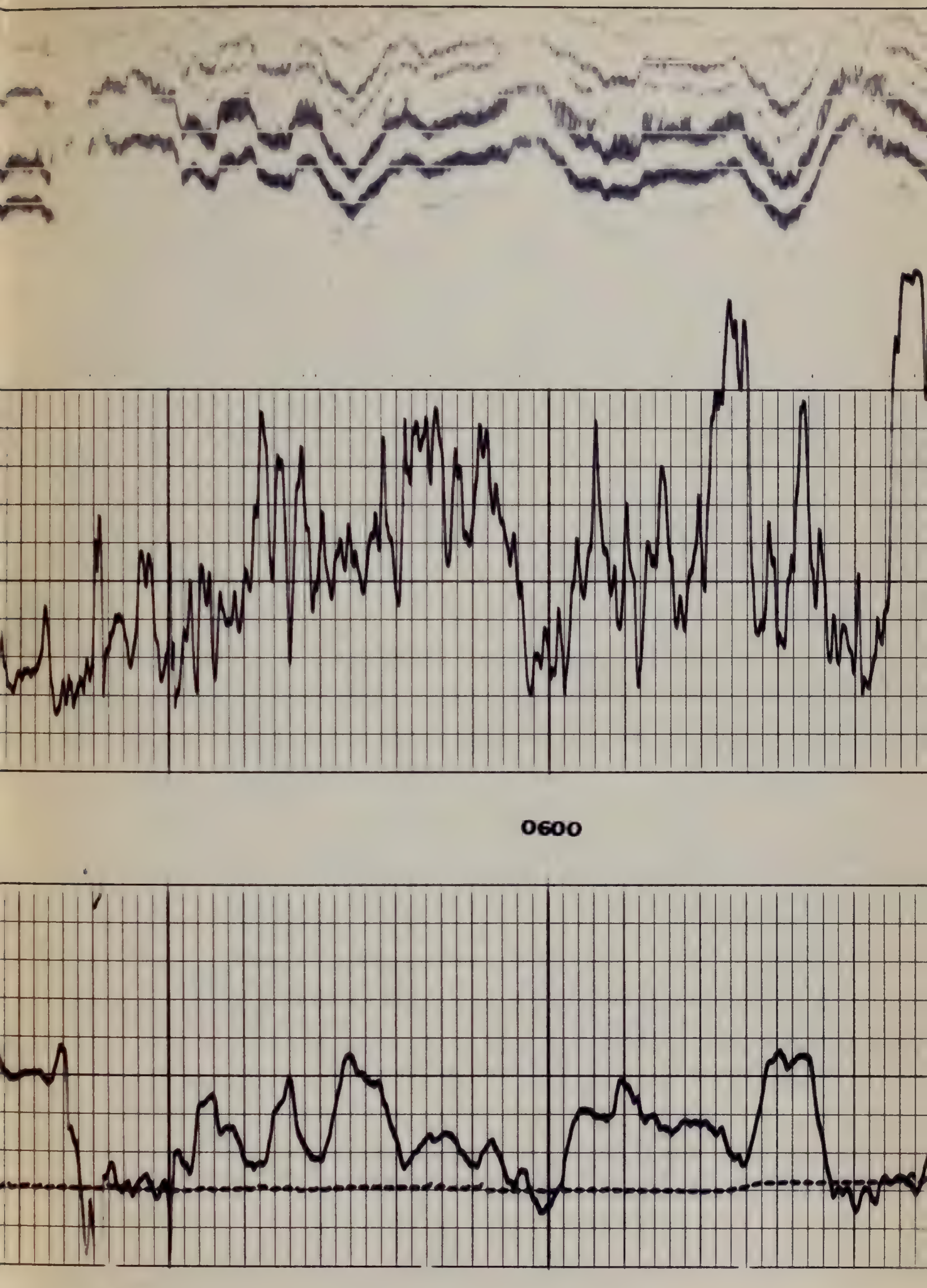
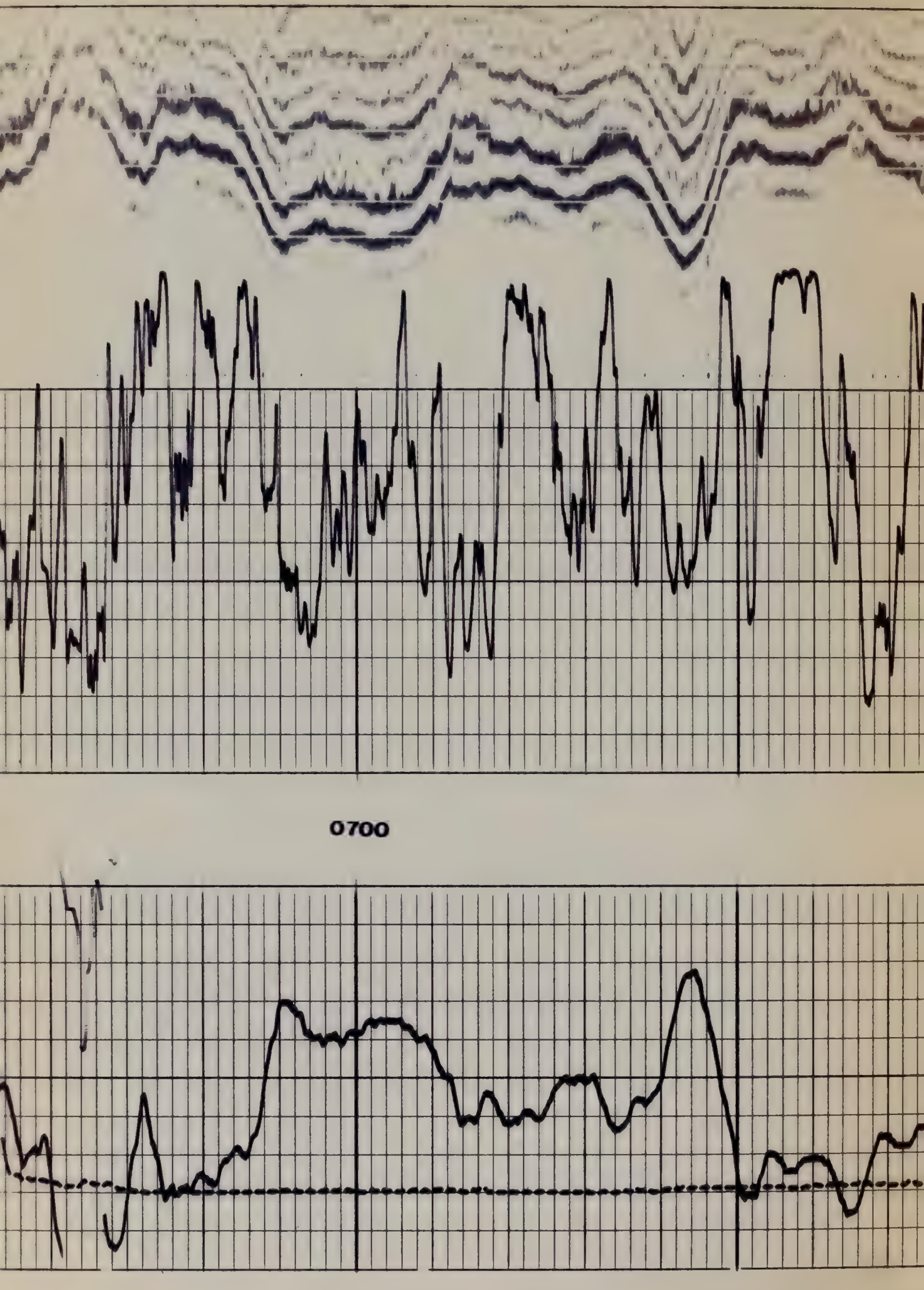

0900
6
16
CALIPER
HOLE DIAM. IN INCHES
T 3 R1 2 R2

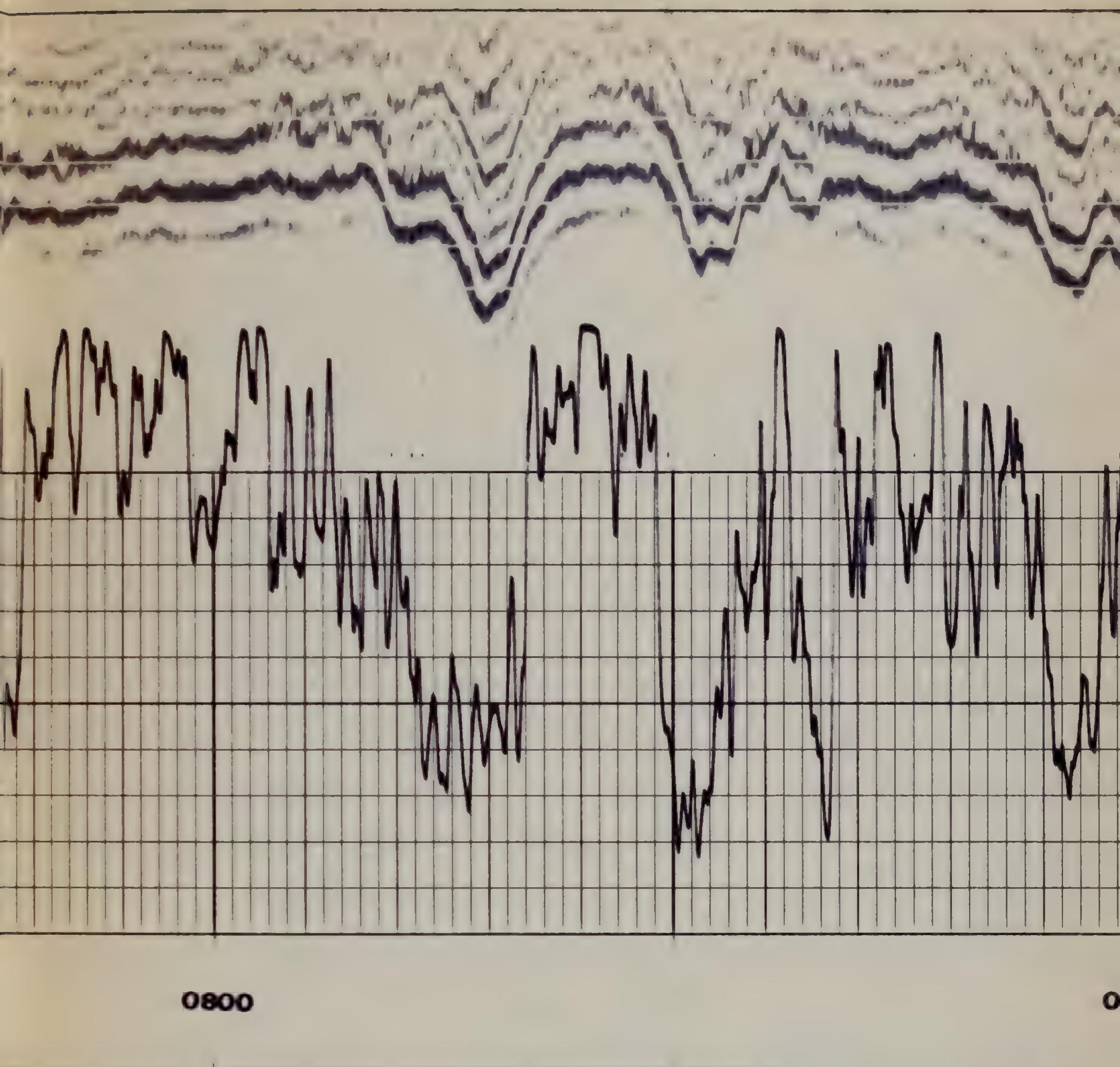

CALIPER
HOLE DIAM IN INCHES
0
150
150
300
GAMMA RAY
API UNITS
SINGLE AT RECEIVER
TIME
MICROSECONDS
495
295
6
CALIPER
16
DEPTHS
150
100
50
250
200
150
INTERVAL TRANSIT TIME
MICROSECONDS PER FOOT
AMPLITUDE
MILLIVOLTS
0
20
VARIABLE DENSITY
MICROSECONDS
200
1200
CUT
CU
04

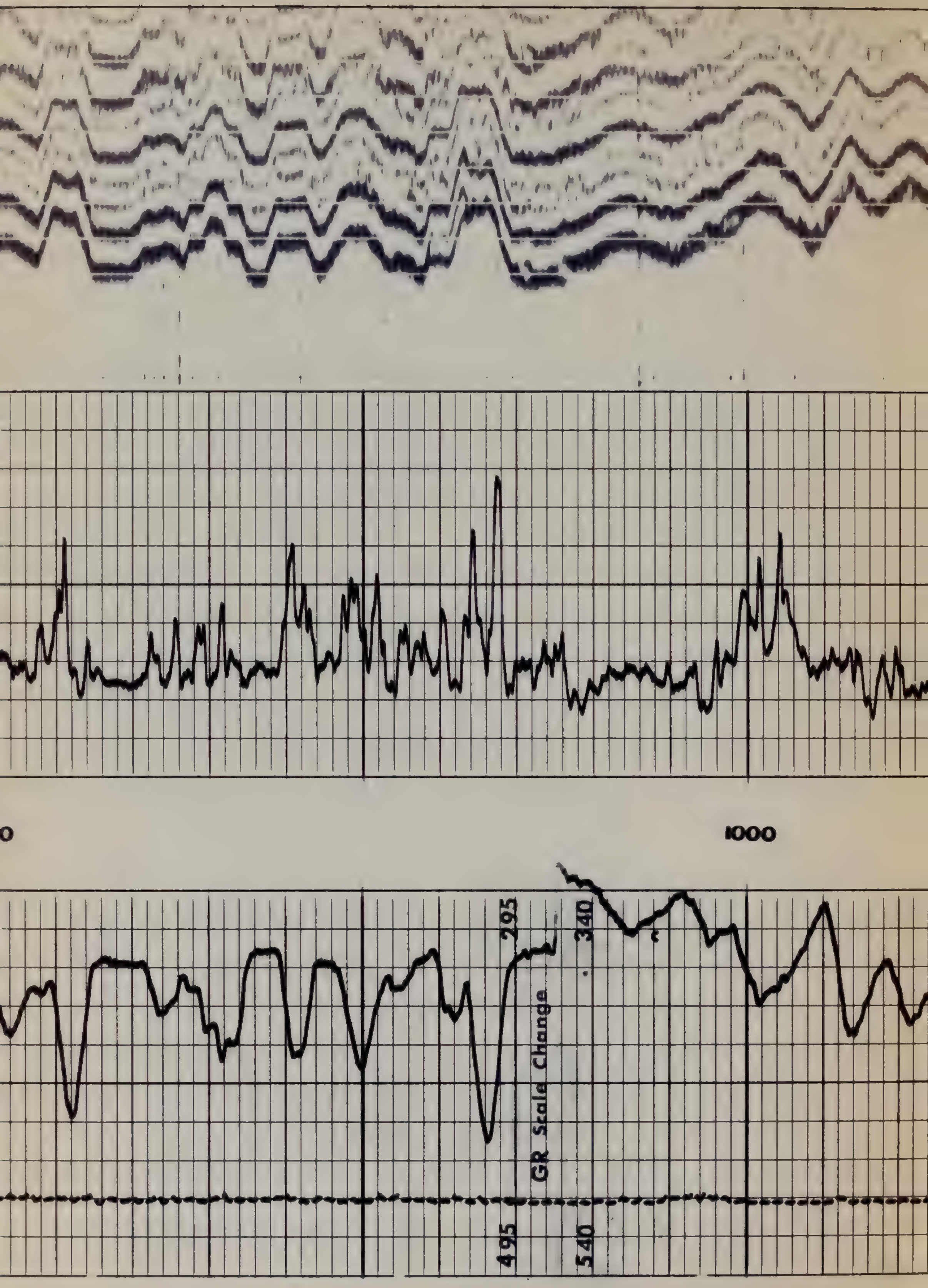

FLUID LEVE
ΔT
GR
Caliper
0500

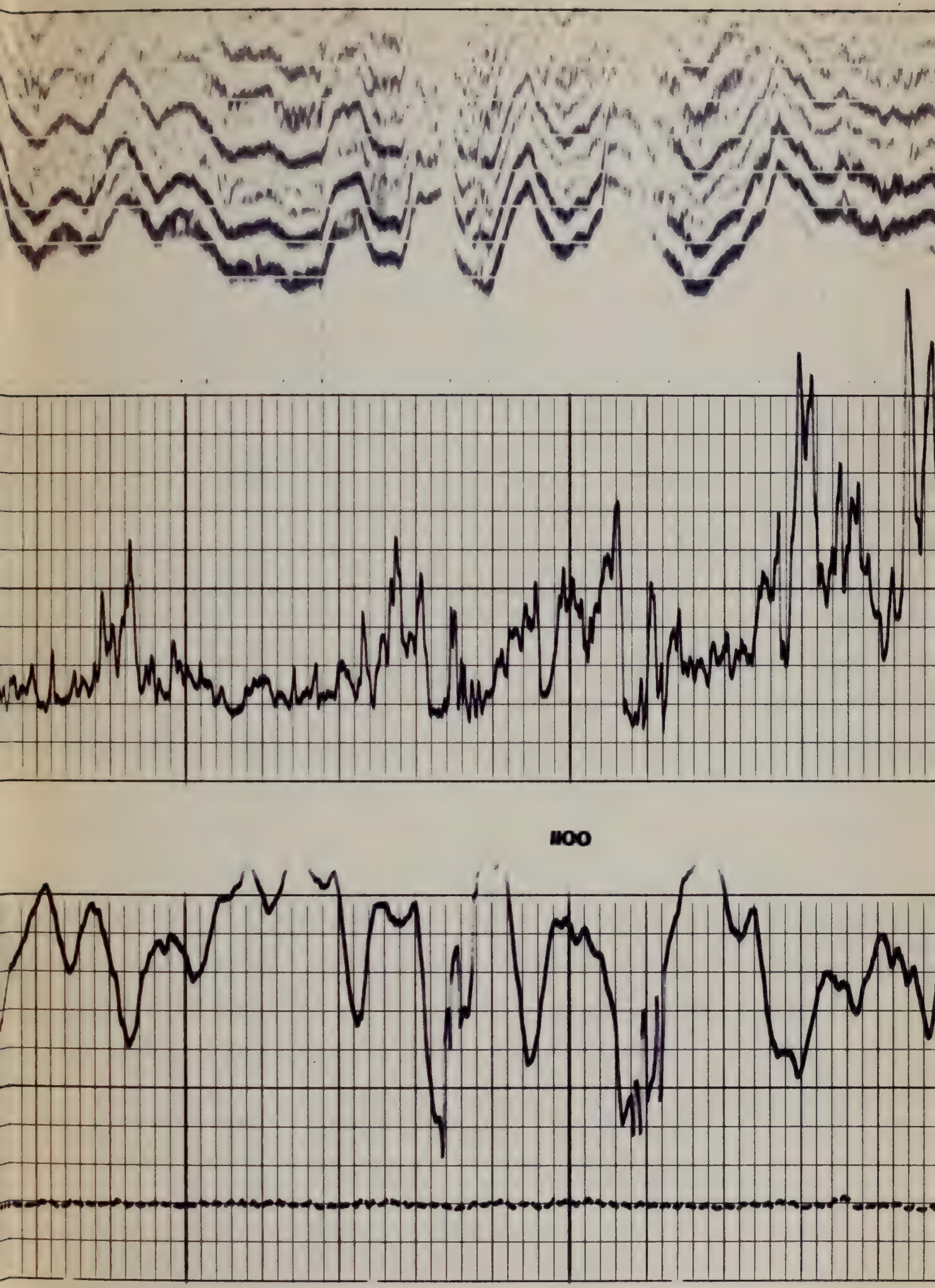

0600

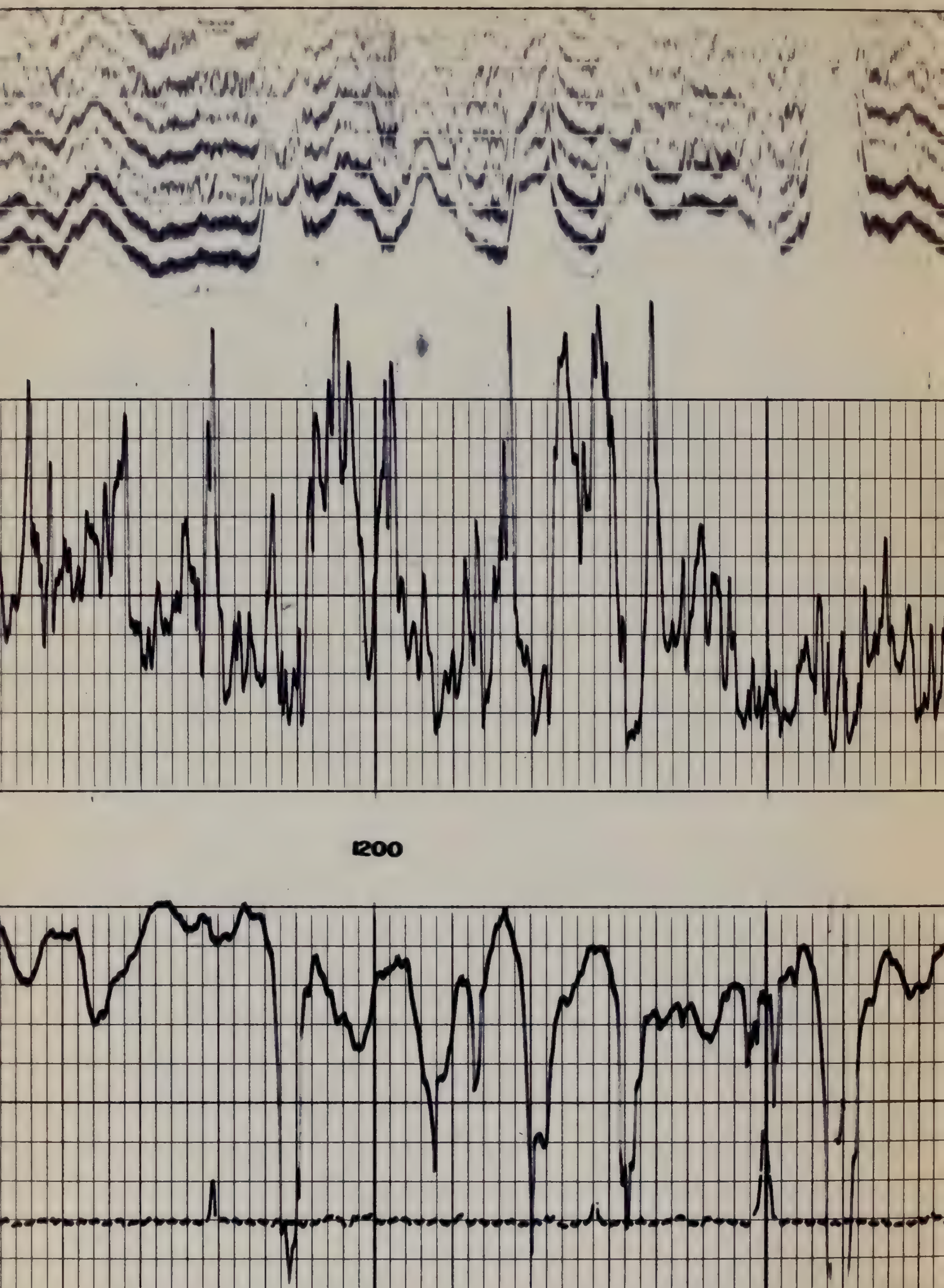


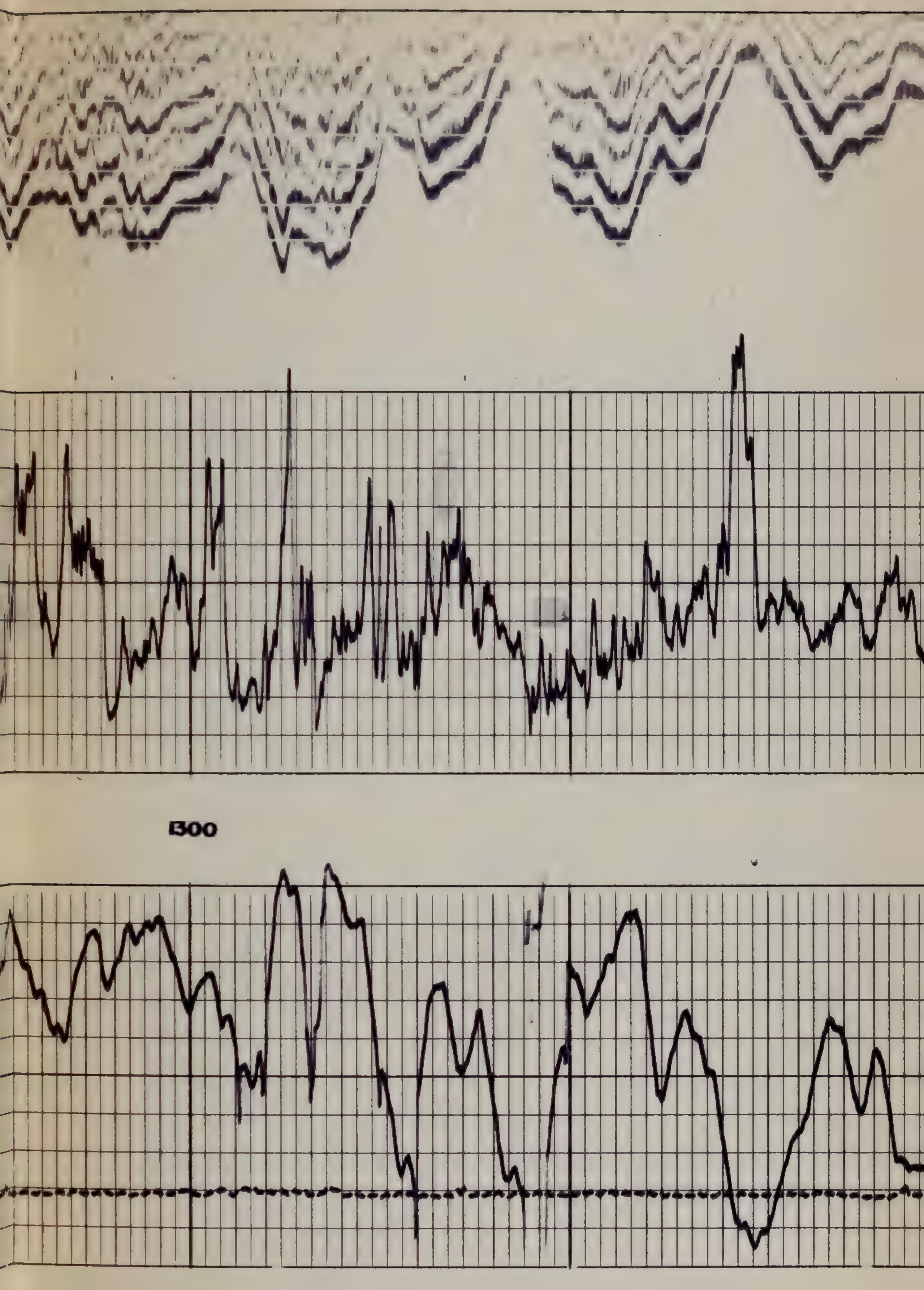
0700


0800
0


0
1000
295
340
GR Scale Change
495
540


1100


1200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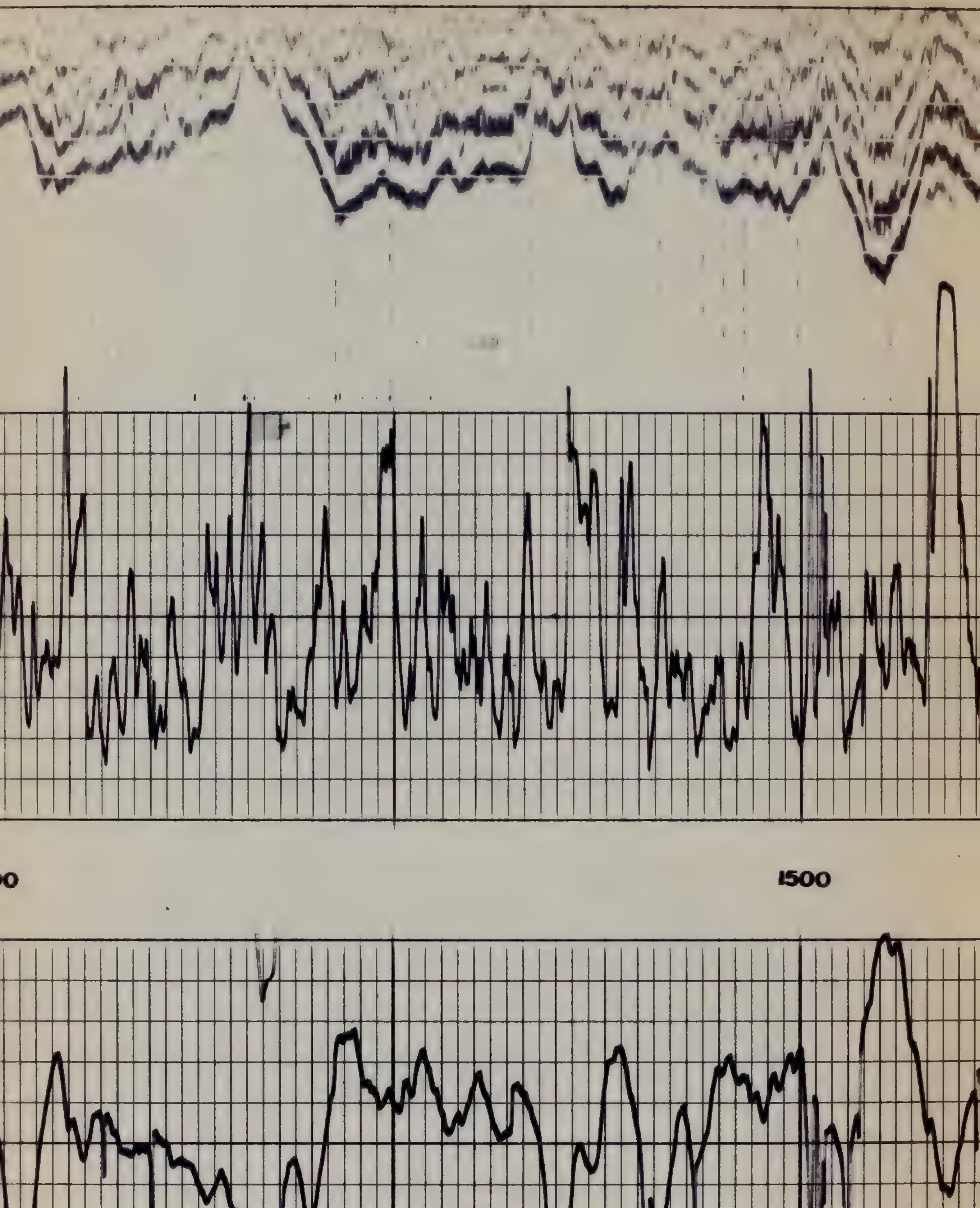
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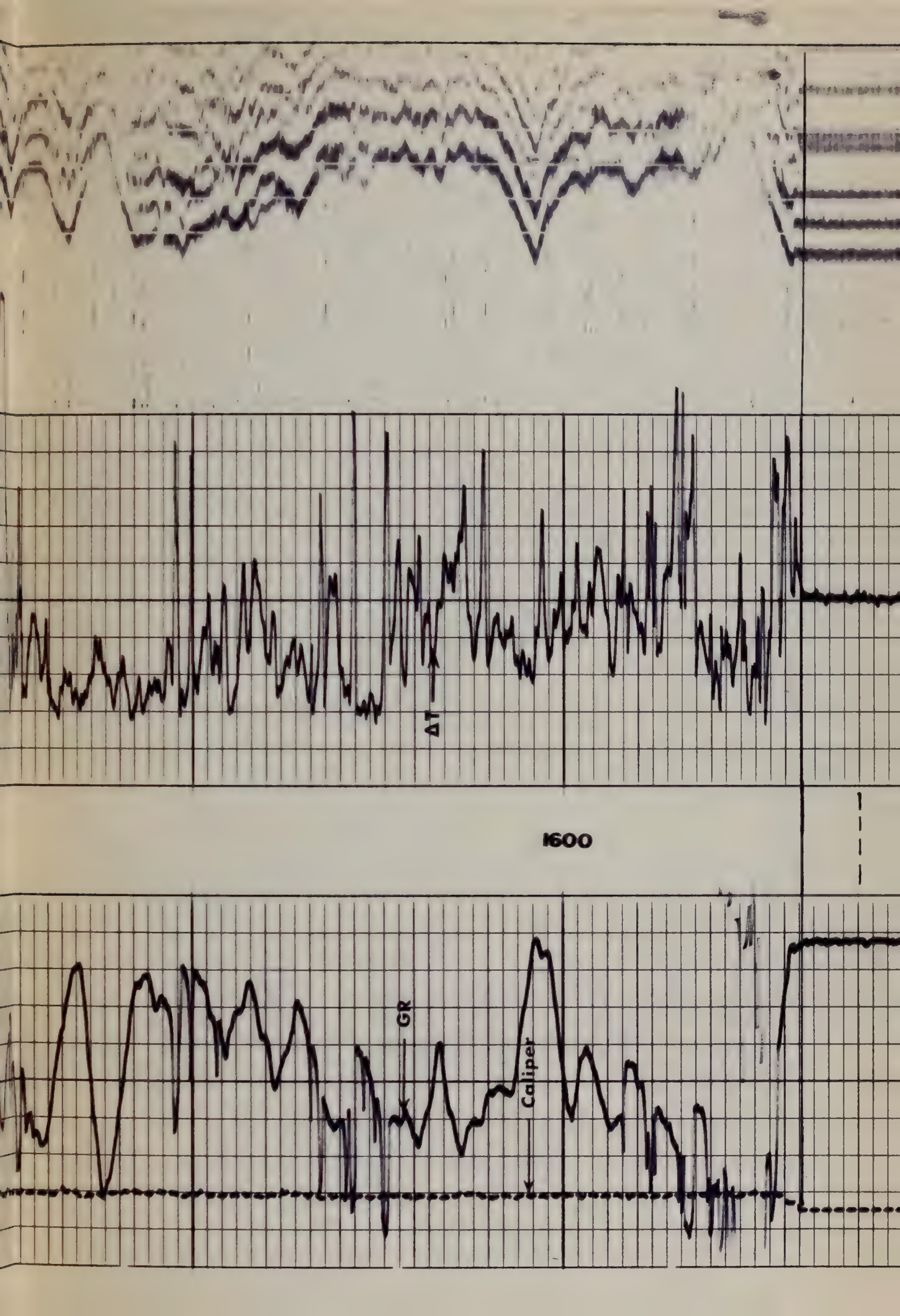

ΔT
1600
GR
Caliper

6 _ _ _ CALIPER _ _ _ 16

540 340

SINGLE AT RECEIVER
TIME
MICROSECONDS

AMPLITUDE MILLIVOLTS

0 20

VARIABLE DENSITY
MICROSECONDS

200 1200

COMPANY THE ATLANTIC RICHFIELD COMPANY

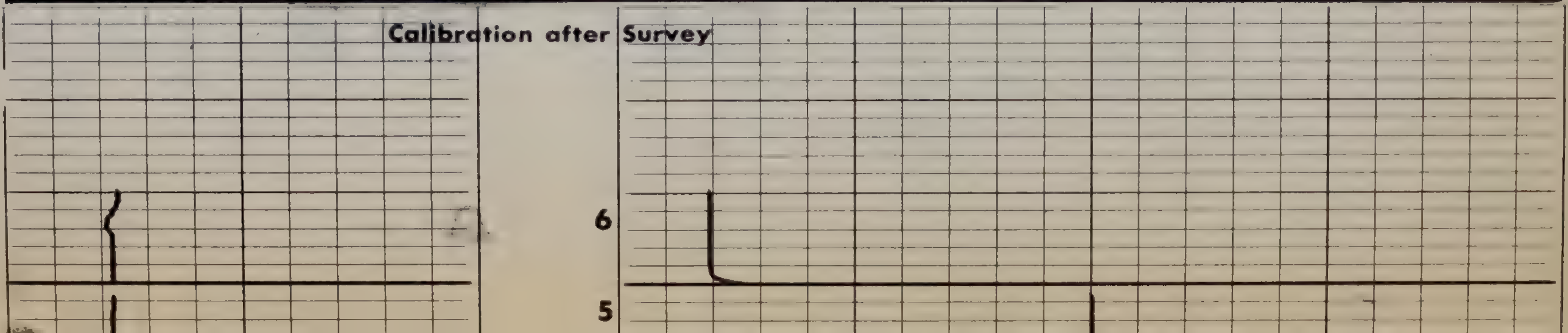
WELL AQUIFER TEST NO. 1-B

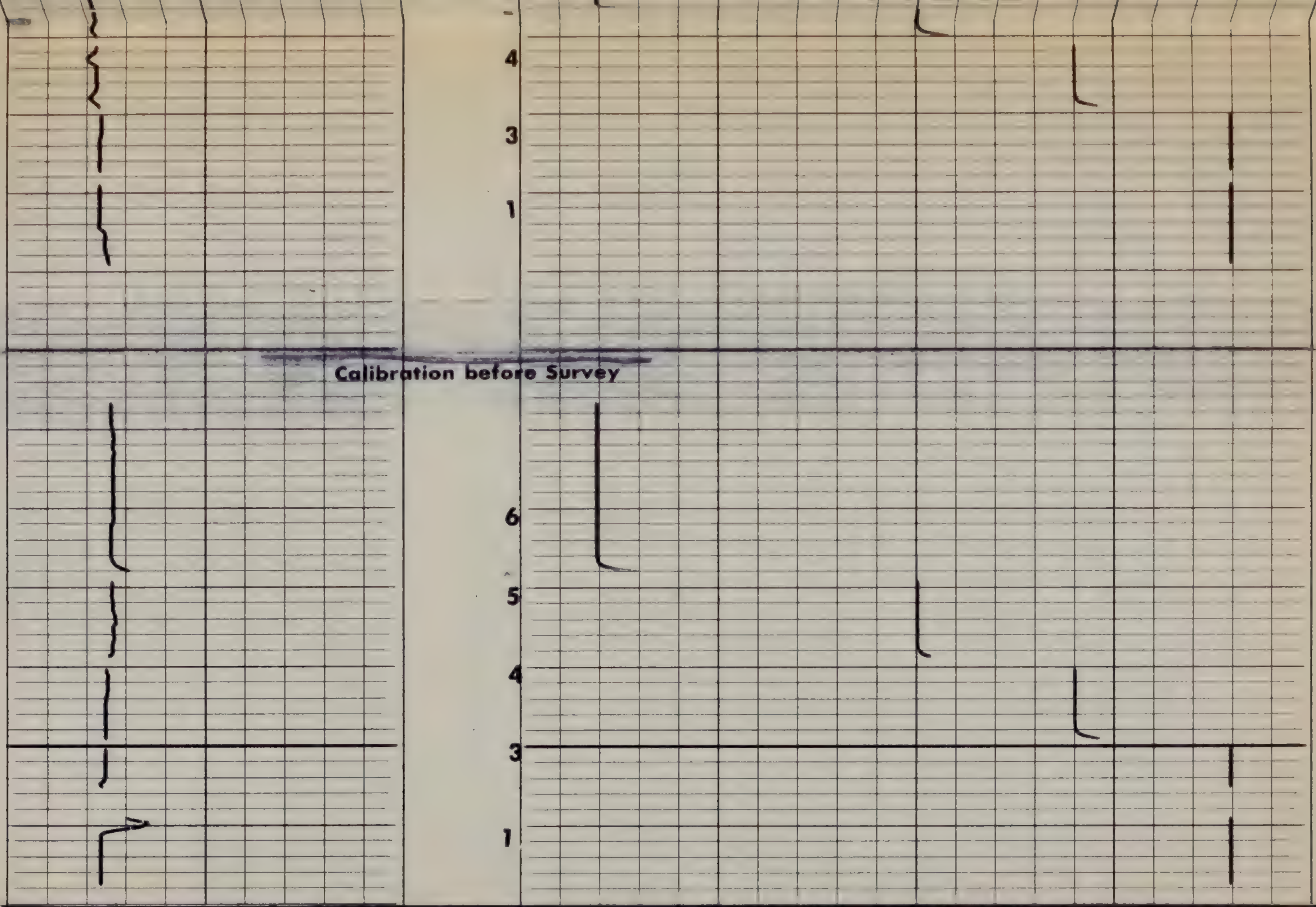
FIELD ----

COUNTY RIO BLANCO STATE COLORADO

SCHL. FR 1640
SCHL. TD 1642
DRLR TD 1638
Elev:
KB ----
DF ----
GL 6909

CALIBRATION DATA





BOREHOLE COMPENSATED SONIC CALIBRATION CODING

3. 60 μ SEC/FT
4. 80 μ SEC/FT
5. 100 μ SEC/FT
6. 140 μ SEC/FT

GAMMA RAY CALIBRATION CODING

1. MECHANICAL ZERO
2. ELECTRICAL ZERO
3. RECORDER SENSITIVITY
4. MEMORIZER ADJUSTMENT
5. BACKGROUND
6. CALIBRATION

⬆

CALIBRATION DATA

COMPANY THE ATLANTIC RICHFIELD COMPANY

WELL AQUIFER TEST NO. 1-B

FIELD ----

COUNTY RIO BLANCO STATE COLORADO

SCHL. FR 1640
SCHL. TD 1642
DRLR TD 1638
Elev:
KB ----
DF ----
GL 6909

SWS-1048-B

Schlumberger

SIMULTANEOUS

COMPENSATED NEUTRON-FORMATION DENSITY

COUNTY RIO BLANCO
FIELD or LOCATION ----
WELL AQUIFER TEST NO. 1-B
COMPANY ATLANTIC RICHFIELD

COMPANY THE ATLANTIC RICHFIELD COMPANY

WELL AQUIFER TEST NO.1-B

FIELD ----

COUNTY RIO BLANCO STATE COLORADO

Location: API Serial No. 01036

Sec. 7 Twp. 3S Rge. 96W

Other Services:
DIL ENG.PRO
FDC-GR
BHC-GR

Permanent Datum: GL ; Elev.: 6909
Log Measured From GL , 0 Ft. Above Perm. Datum
Drilling Measured From GL

Elev.: K.B. ----
D.F. ----
G.L. 6909

Date	7-21-74			
Run No.	ONE			
Depth—Driller	1638			
Depth—Logger	1641			
Btm. Log Interval	1640			
Top Log Interval	72			
Casing—Driller	8-5/8@ 60	@	@	@
Casing—Logger	72			
Bit Size	7-7/8			
Type Fluid in Hole	WATER			
Fluid Level	410			
Dens. | Visc.	8.3 |	|	|	|
pH | Fluid Los	---- | -- ml	| ml	| ml	| ml
Source of Sample				
Rmm @ Meas. Temp.	@ °F	@ °F	@ °F	@ °F
Rmf @ Meas. Temp.	@ °F	@ °F	@ °F	@ °F
Rmc @ Meas. Temp.	@ °F	@ °F	@ °F	@ °F
Source: Rmf | Rmc	|	|	|	|
Rm @ BHT	@ °F	@ °F	@ °F	@ °F
Time Since Circ.	26 HRS.			
Max. Rec. Temp.	90 °F	°F	°F	°F
Equip. | Location	5602 | G.J.	|	|	|
Recorded By	SCHNORR			
Witnessed By	TAIT			

SWS-1872-E

CHANGES IN MUD TYPE OR ADDITIONAL SAMPLES

Date / Sample No.		
Depth - Driller		
Type Fluid		
Source of Sample		
Rm @ Meas. Temp.	@ °F	@ °F
Rmf @ Meas. Temp.	@ °F	@ °F
Rmc @ Meas. Temp.	@ °F	
Rm @ BHT	@ °F	
Dens. / Visc.		
ph / Fluid Loss	ml	ml
% Water by Vol.		
% Oil by Vol.		
% Solids by Vol.		
Solids Av. Sp. Gr.		

SCALE CHANGES

Type Log	Depth	Scale Up Hole	Scale Down Hole

EQUIPMENT DATA

Run No.	ONE			
Dens. Pnl.	EA-169			
Dens. Cart	EA-289			
Dens. Skid	E-90			
Dens. Sde	P-436			
Dens. Source	3098			
Dens. Calib.	210			
Neut. Pnl.	A-205			
Neut. Cart	A-199			
Neut. Source	---			
Neut. Calib	A-206			
GR Cart	KG-311			
TTR	----			
Mem Pnl.	B-260			

LOGGING DATA

CNP

Matrix	Auto Hole Size Corr.	Hole Size Setting (if not auto)	Porosity Scale	From	To
LIME	☒Yes ☐ No		30/TK	1640	72
	☐ Yes ☐ No				
	☐ Yes ☐ No				
	☐ Yes ☐ No				
	☐ Yes ☐ No				

FDC

Liquid Density	Grain Density	Hole Fluid	Porosity Scale	From	To
1.00	2.71	WATER	30/TK	1640	410
.82	2.71	AIR	30/TK	410	72

REMARKS

Service Order No. - SO #01036

BIT SIZE/CASING DATA

Bit	From	To	Csg. Size	Csg. Wt.	From	To
7- 7/8	1638	60	8-5/8		60	GL

CALIBRATION DATA

Run No.	Gamma Ray			CNL—Before Log—ACPS		CNL—After Log—ACPS	
	API Scale	Background CPS	Total CPS	Long Spacing	Short Spacing	Long Spacing	Short Spacing
1	0-150	180	560	119	273	119	273
2							
3							
4							
				FDC — Before Log — ACPS		FDC — After Log — ACPS	
				P_1	P_2	P_1	P_2
1							
2				512	752	512	752
3							
4							

All interpretations are opinions based on inferences from electrical or other measurements and we cannot, and do not guarantee the accuracy or correctness of any interpretations, and we shall not, except in the case of gross or willful negligence on our part, be liable or responsible for any loss, costs, damages or expenses incurred or sustained by anyone resulting from any interpretation made by any of our officers, agents or employees. These interpretations are also subject to Clause 7 of our General Terms and Conditions as set out in our current Price Schedule.

DETAIL LOG

5″ = 100′

GAMMA RAY

API UNITS

0 150

150 300

CALIPER

NEUTRON POROSITY INDEX %

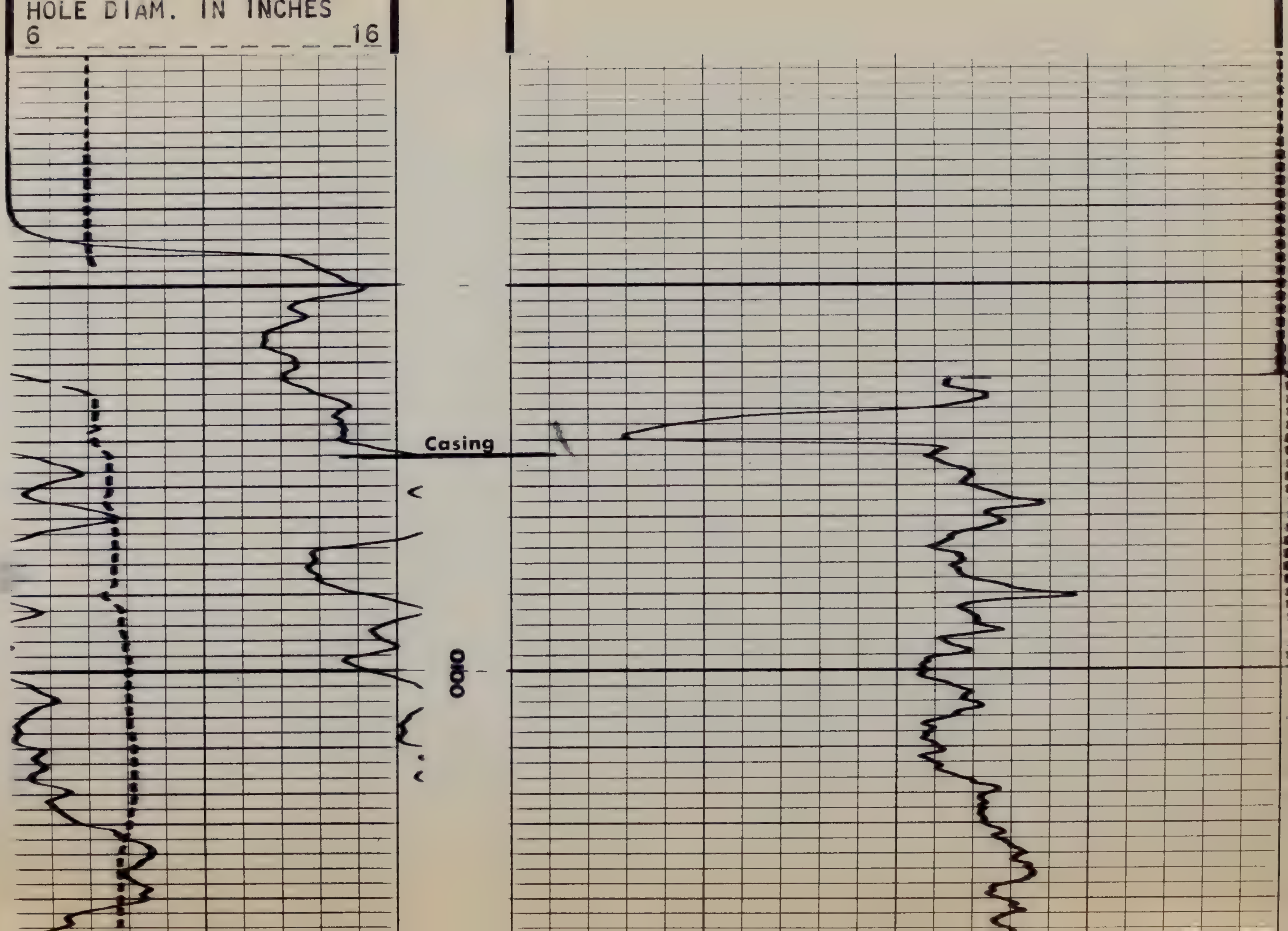
LIMESTONE MATRIX

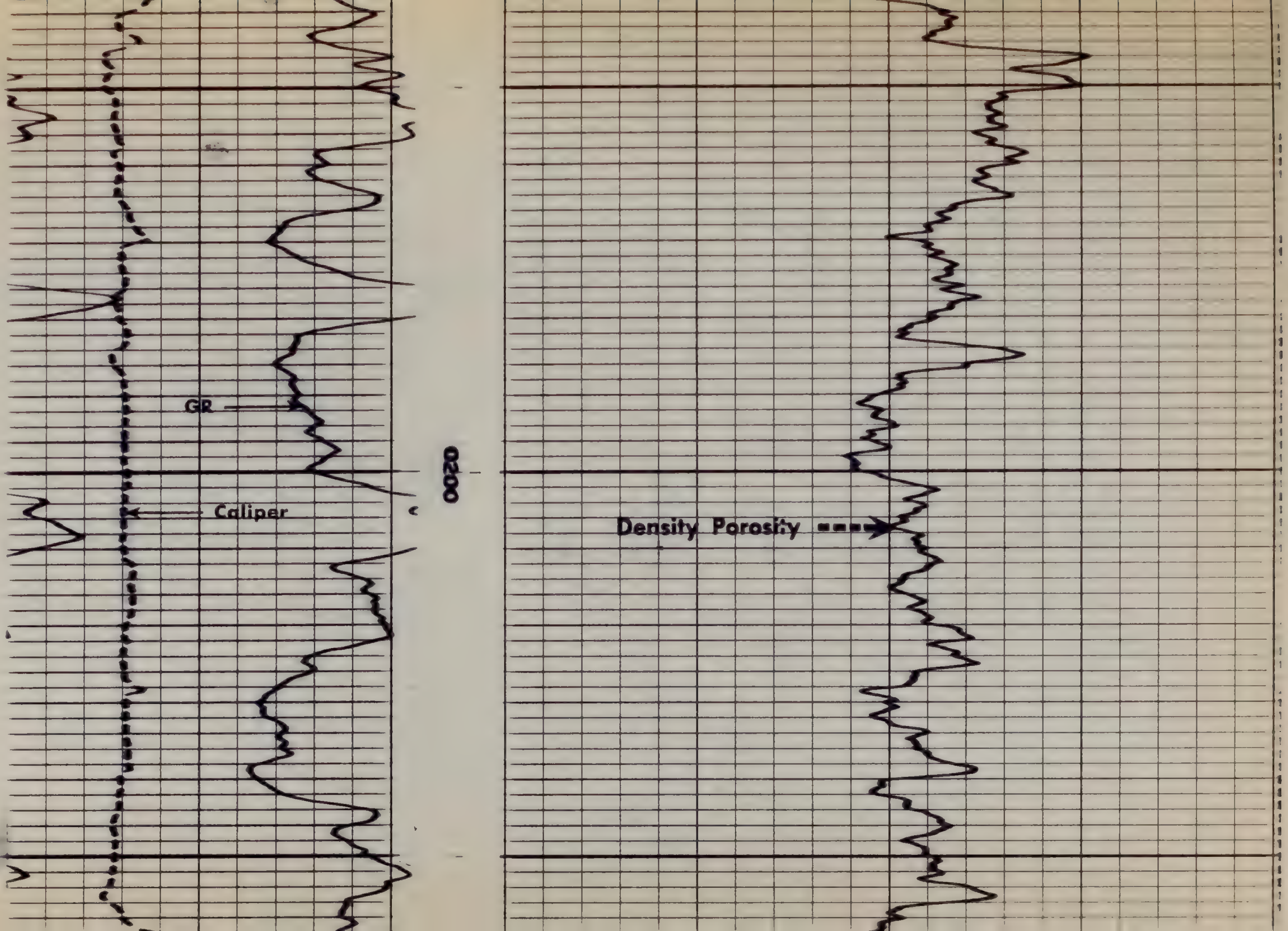
60 45 30 15 0

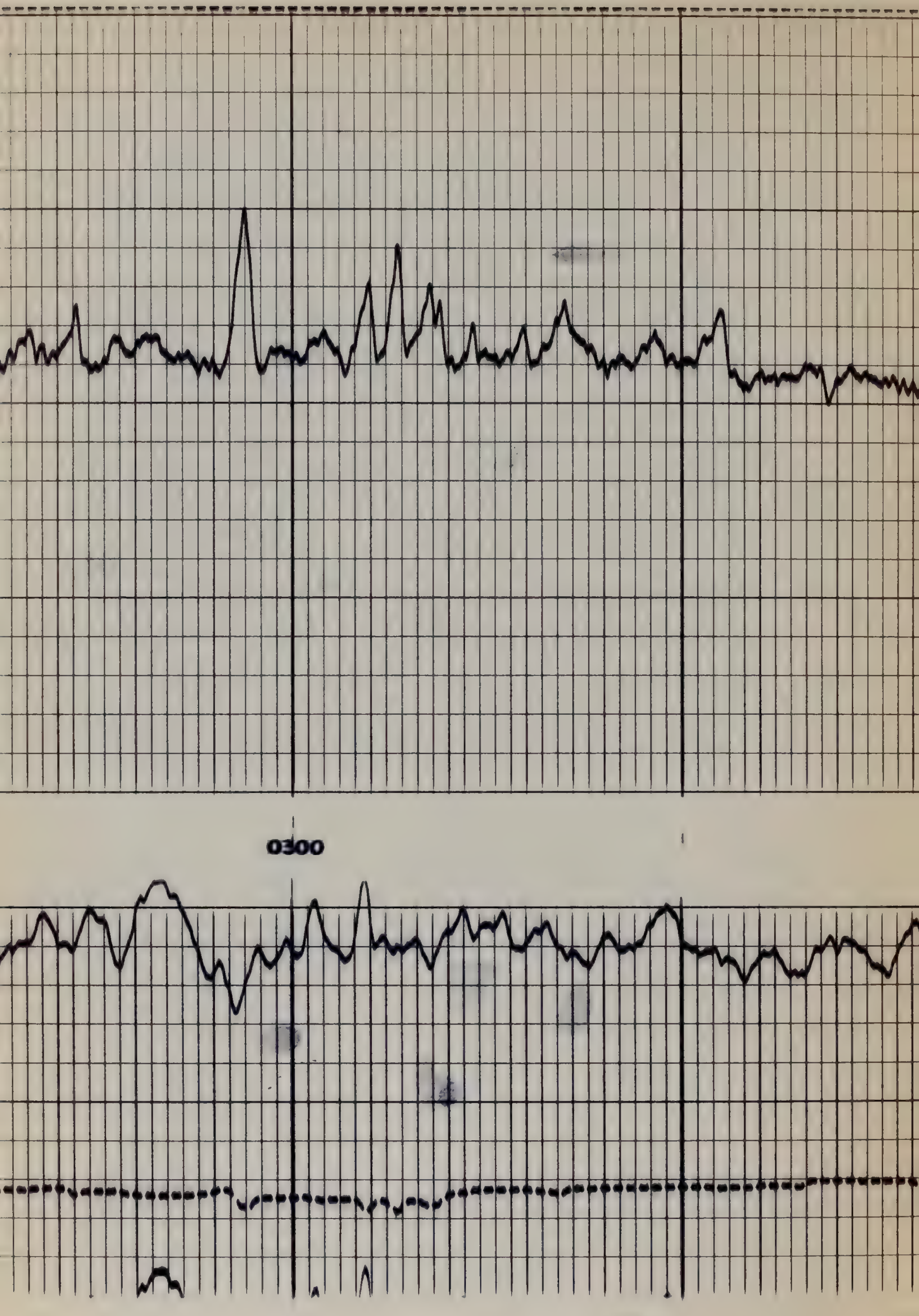
DENSITY POROSITY INDEX %

LIMESTONE MATRIX

60 45 30 15 0


HOLE DIAM. IN INCHES
6
16
Casing
0100


GR
0200
Caliper
Density Porosity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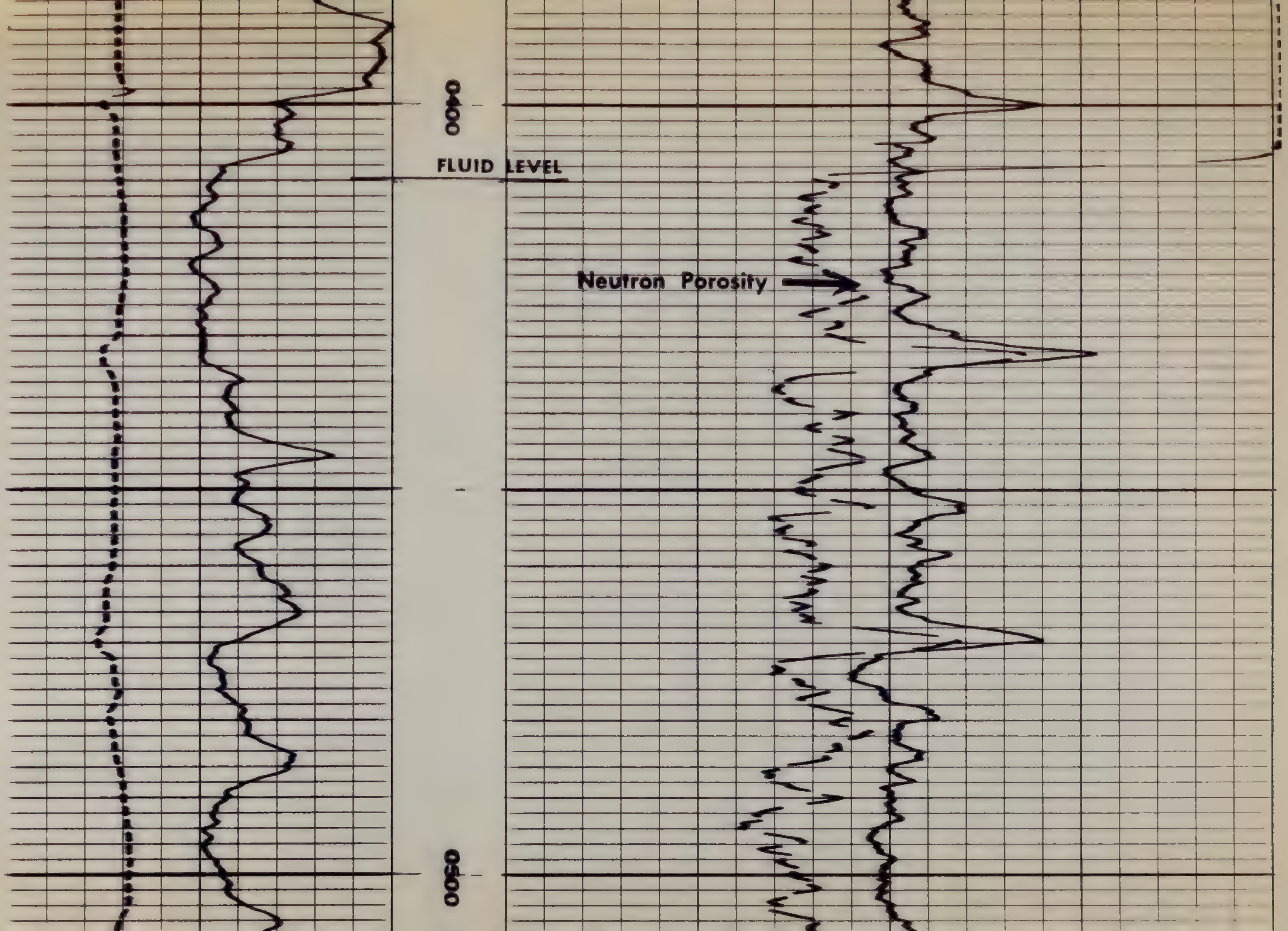
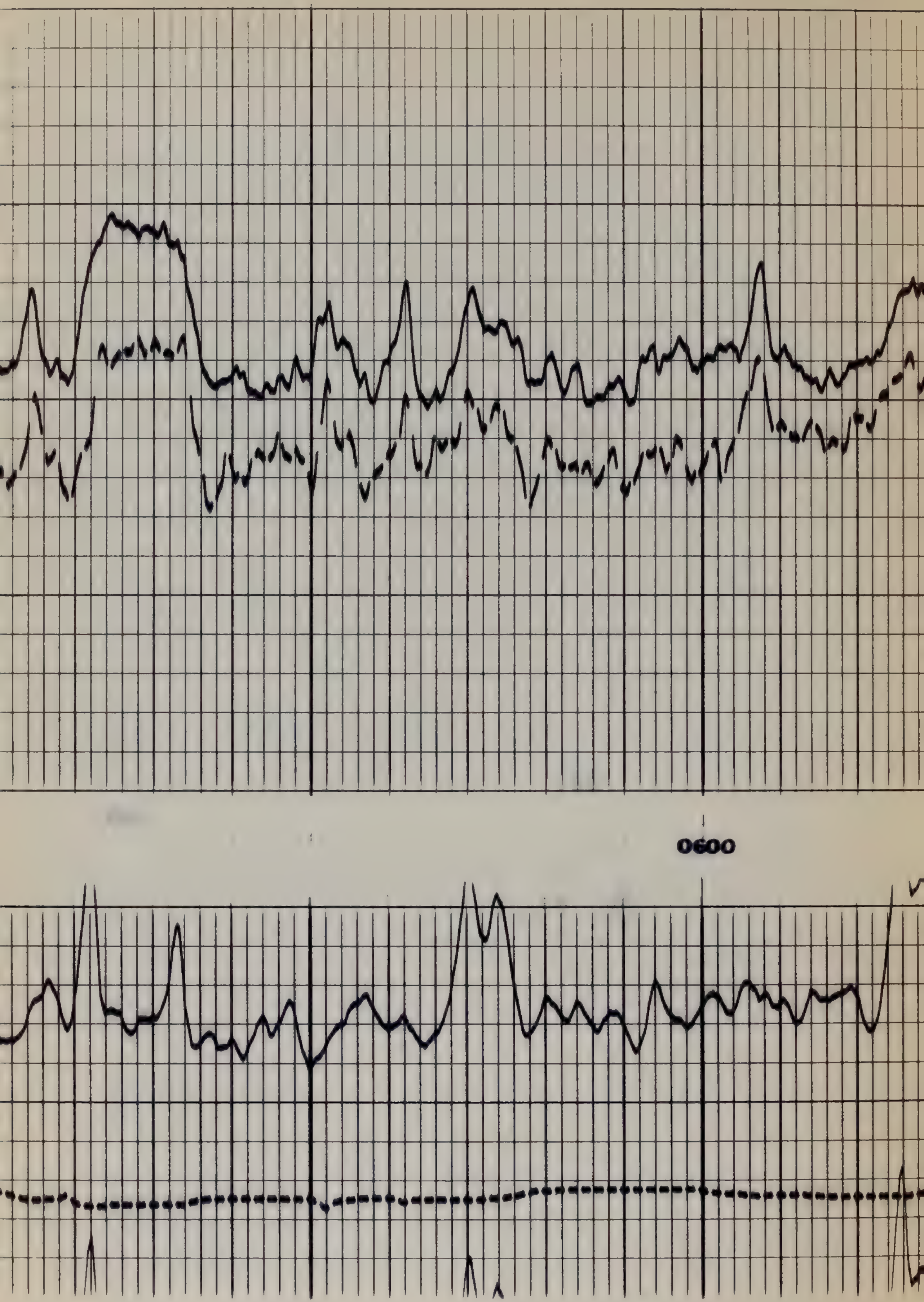

0400
FLUID LEVEL
Neutron Porosity
0500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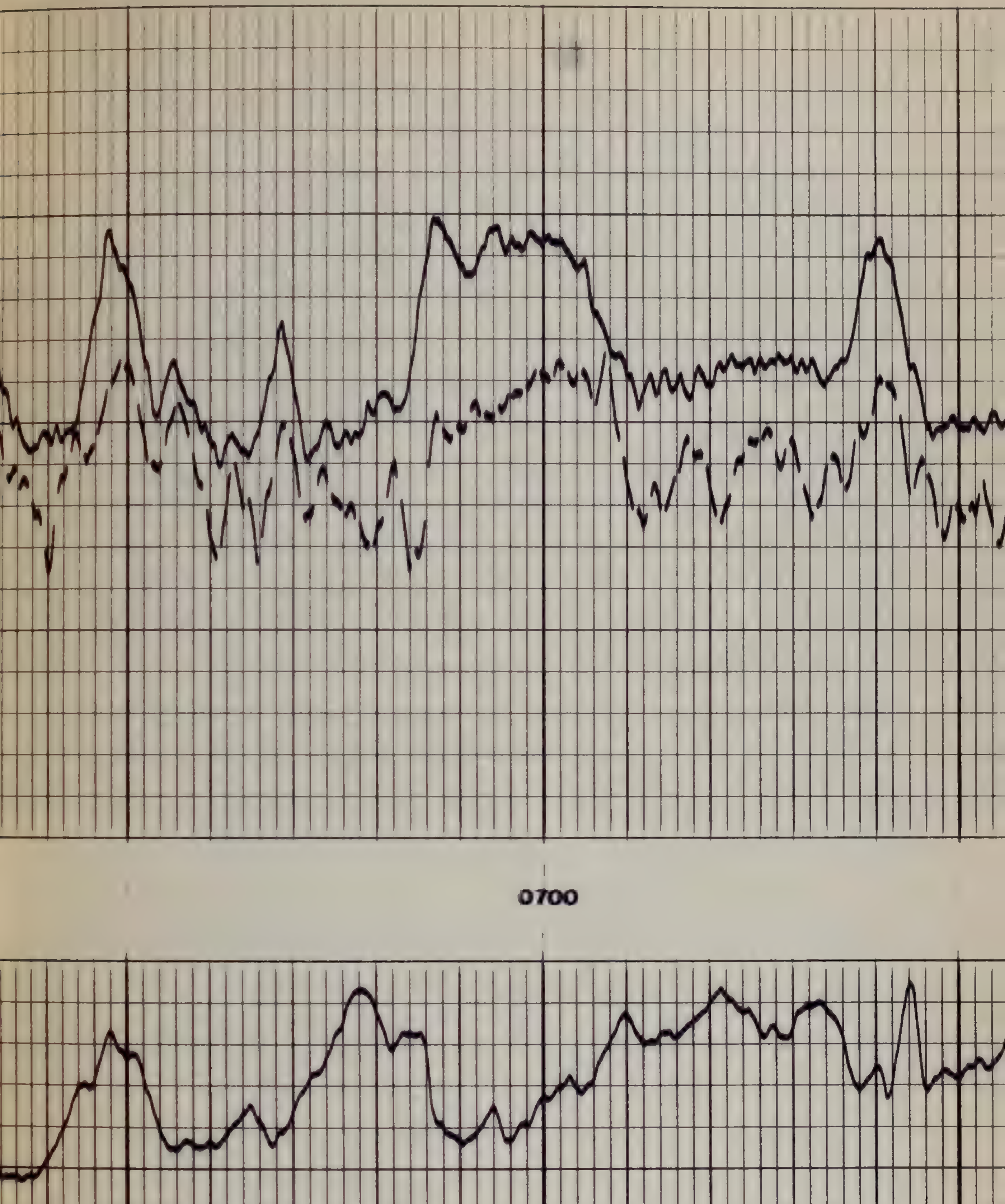
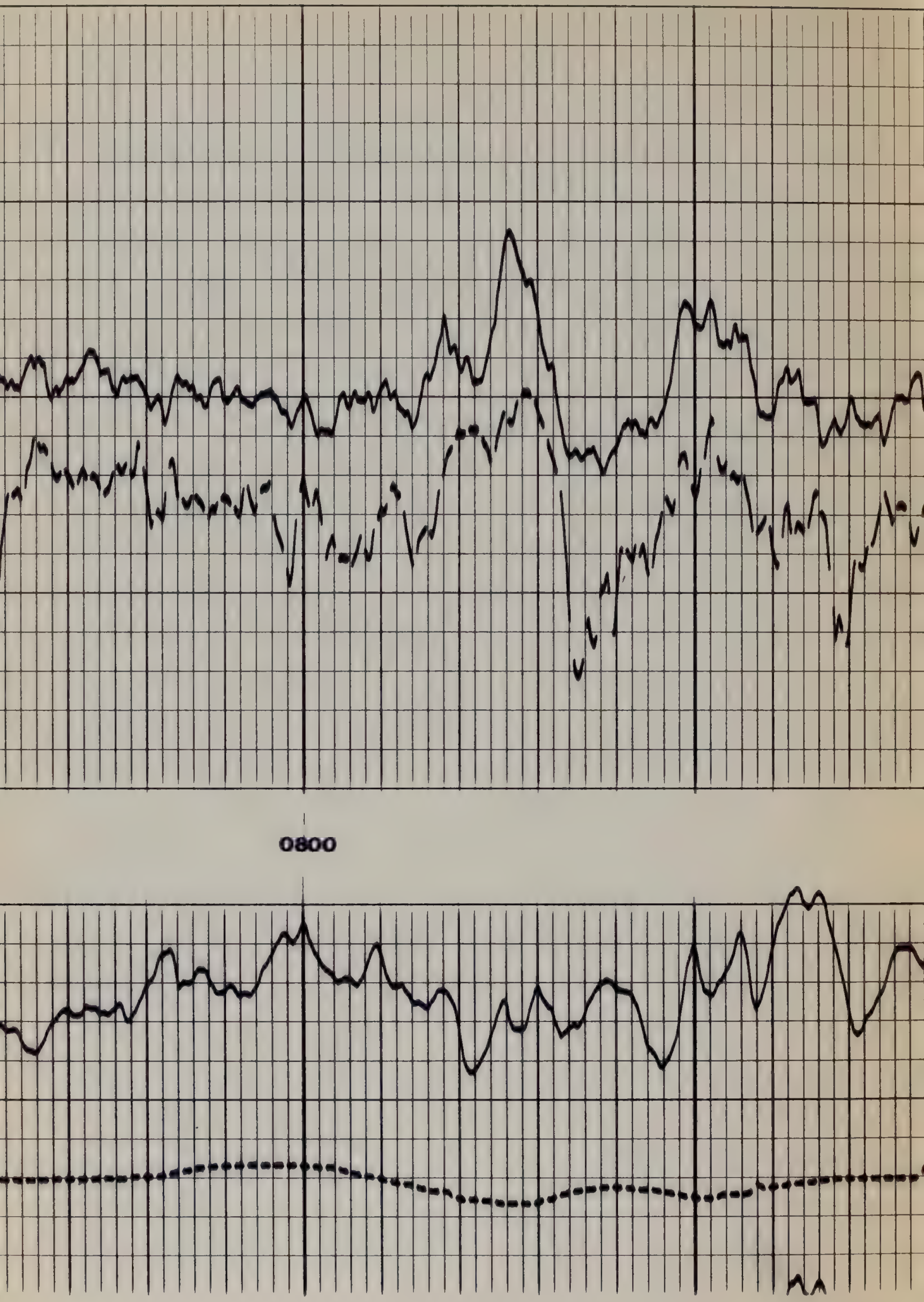

0700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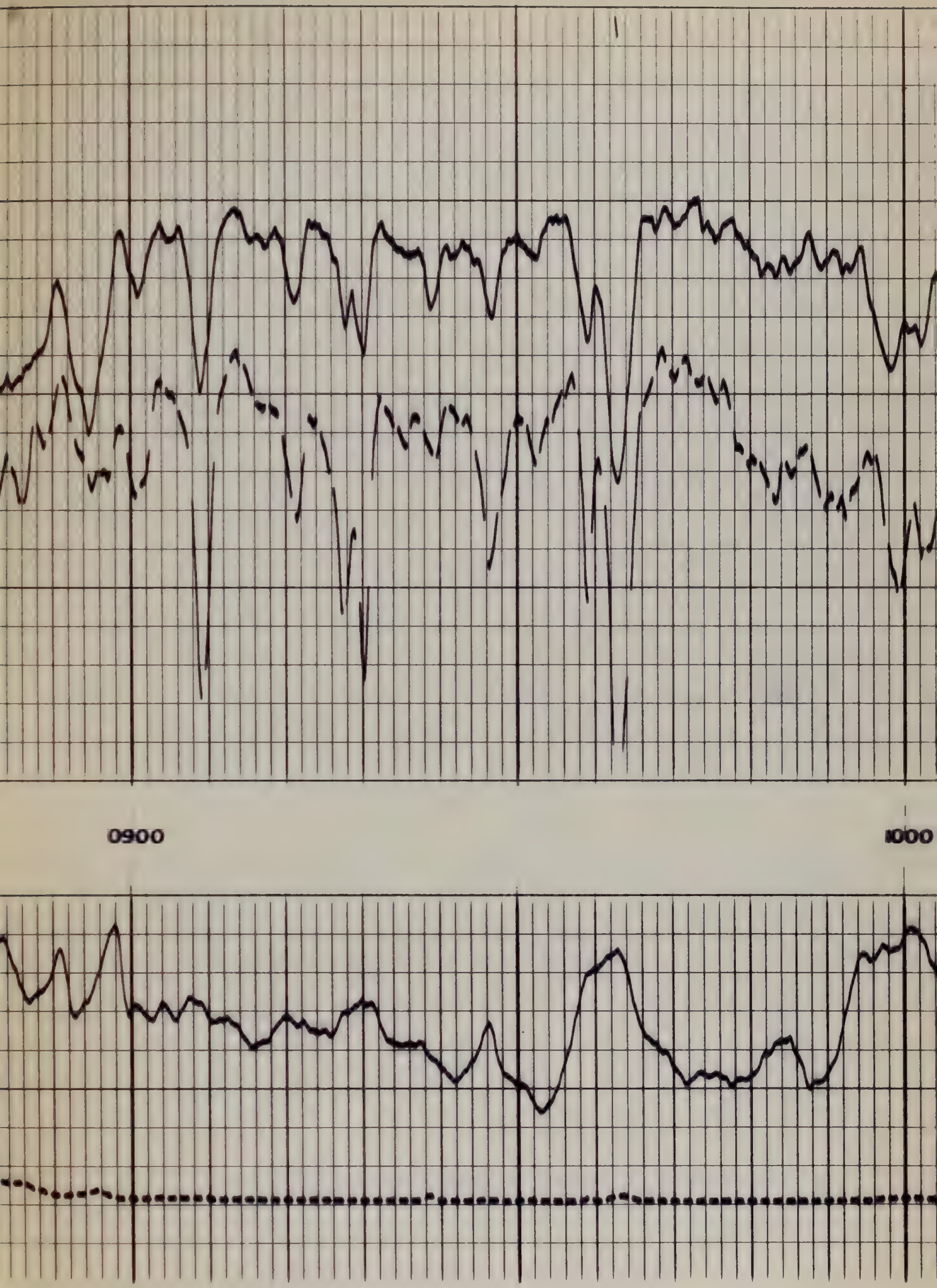
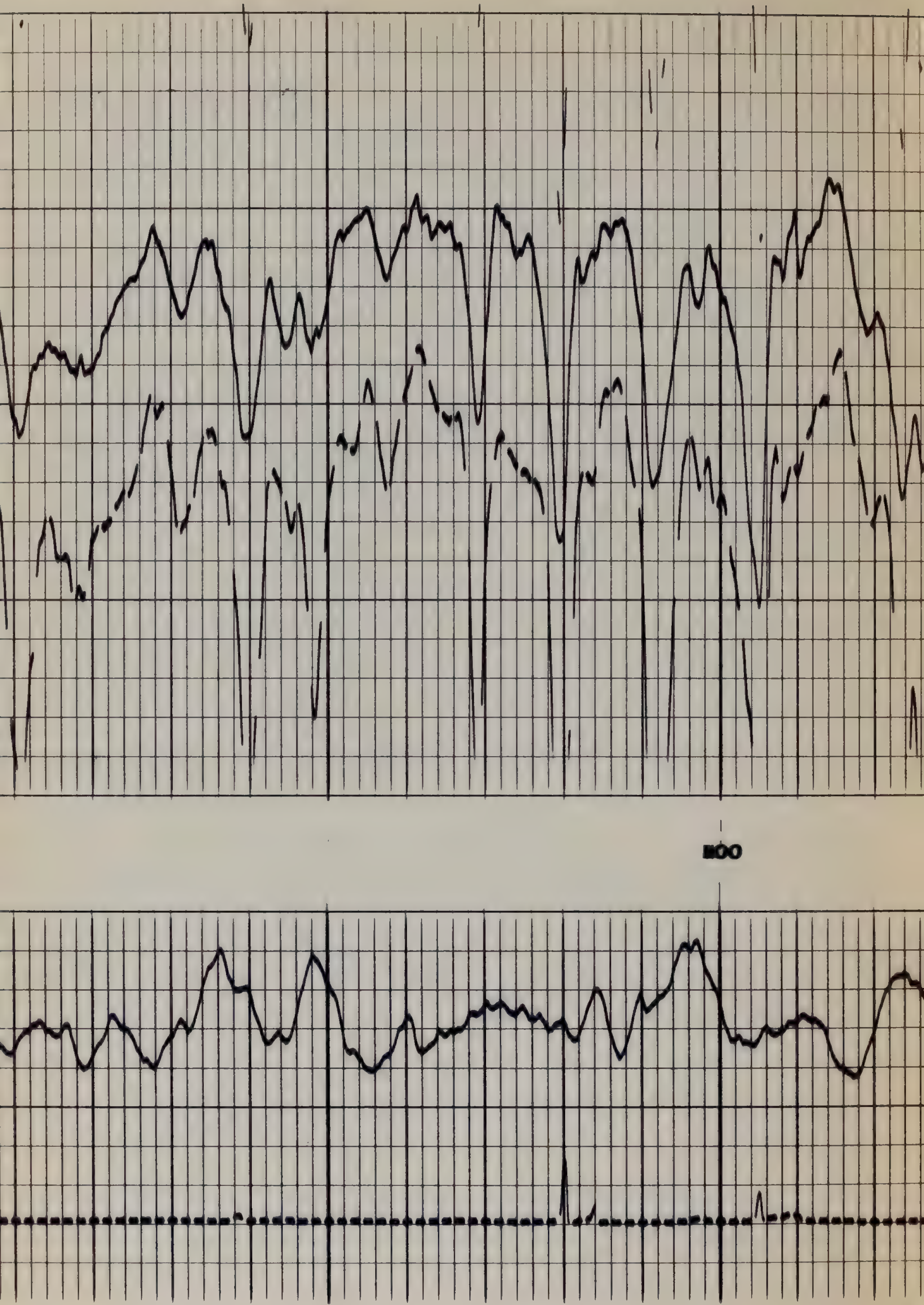

0900
1000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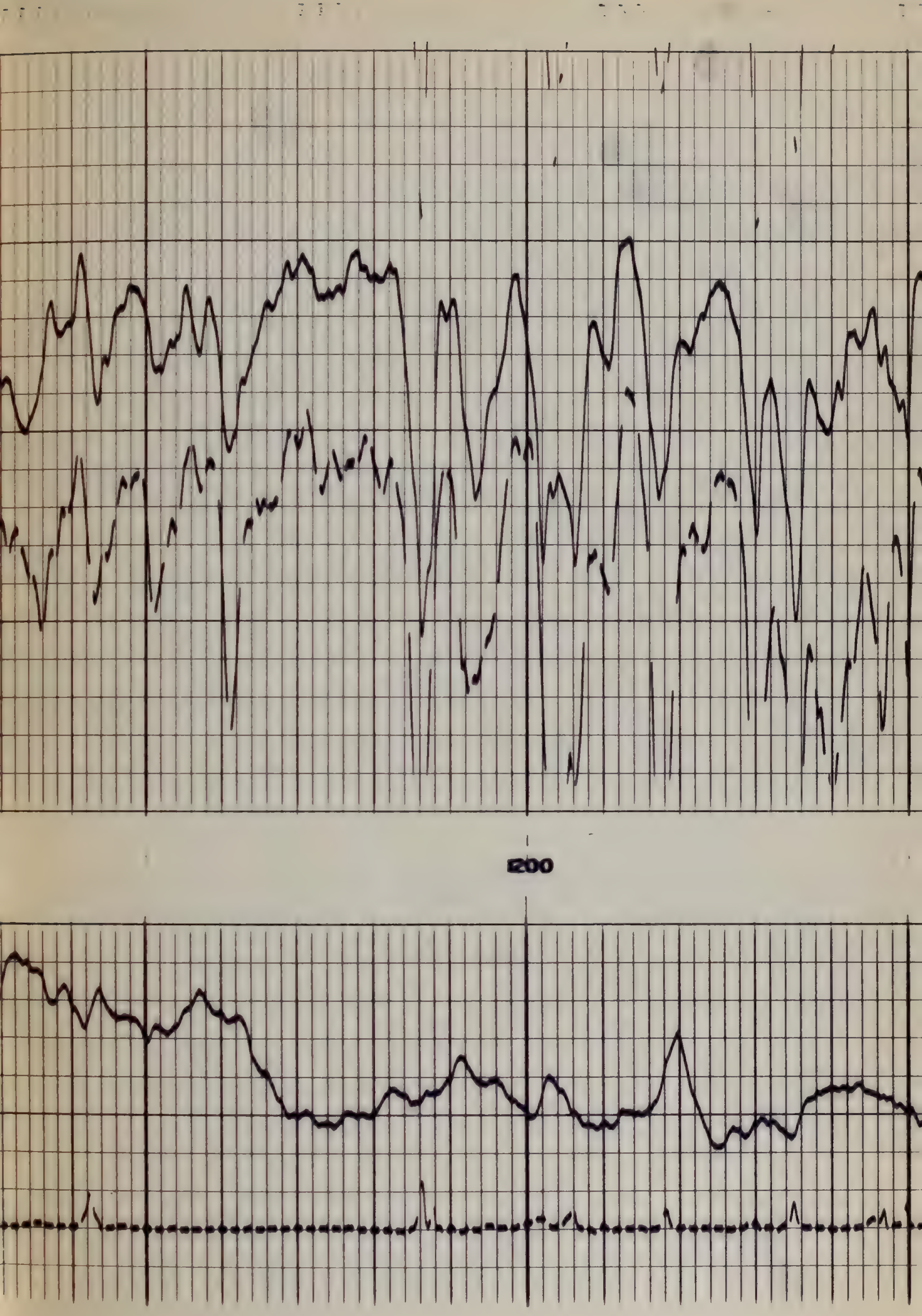
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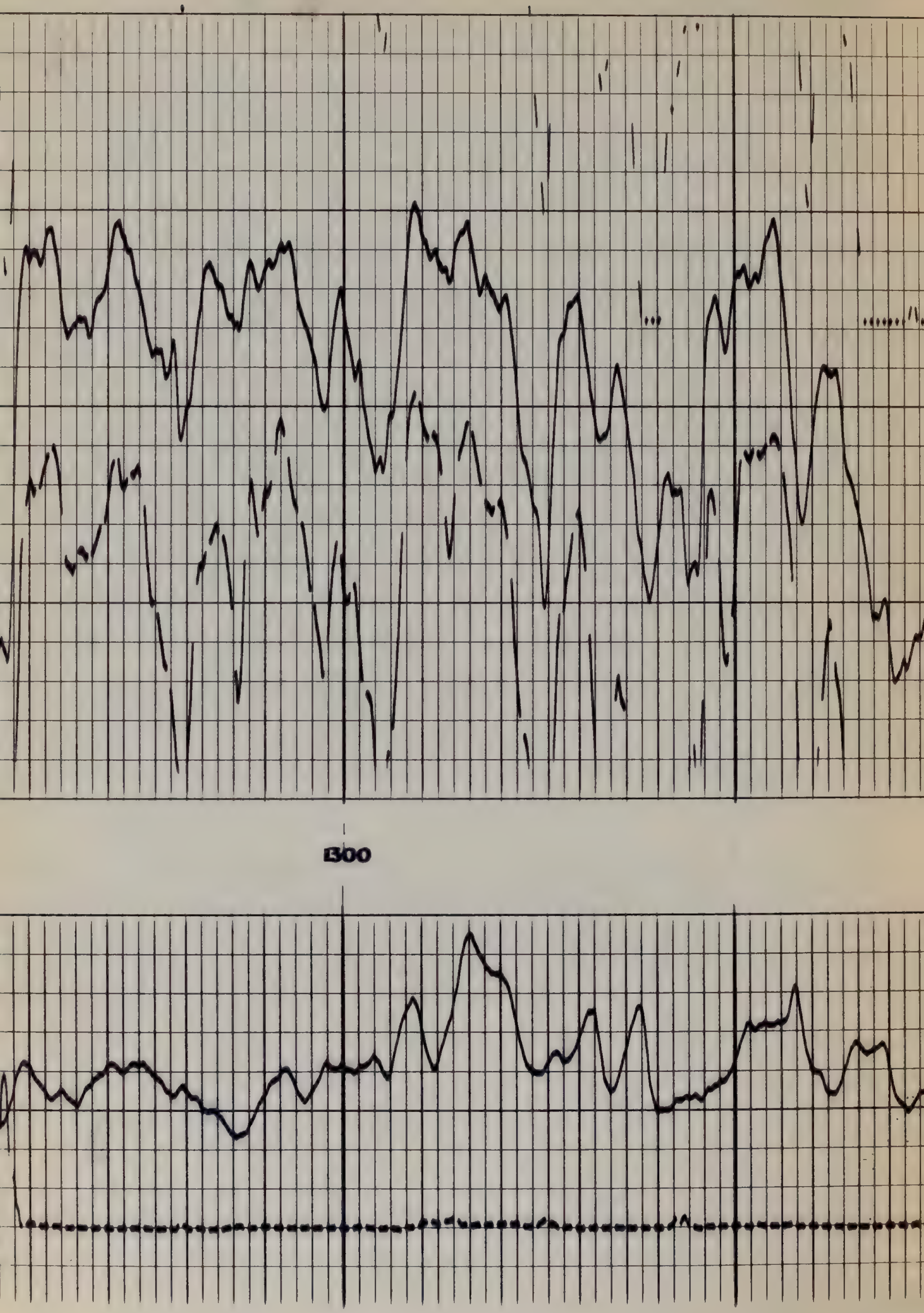
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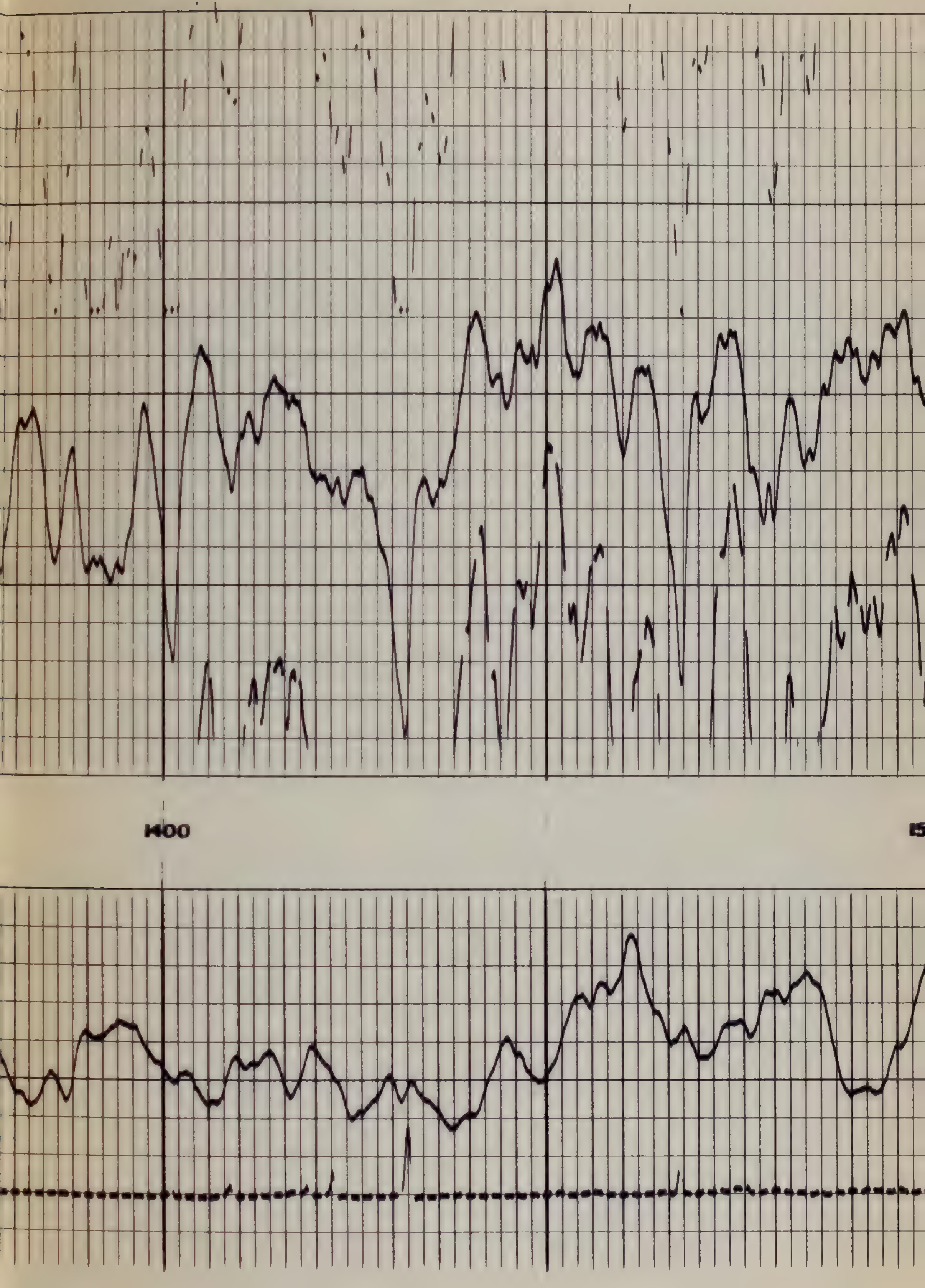
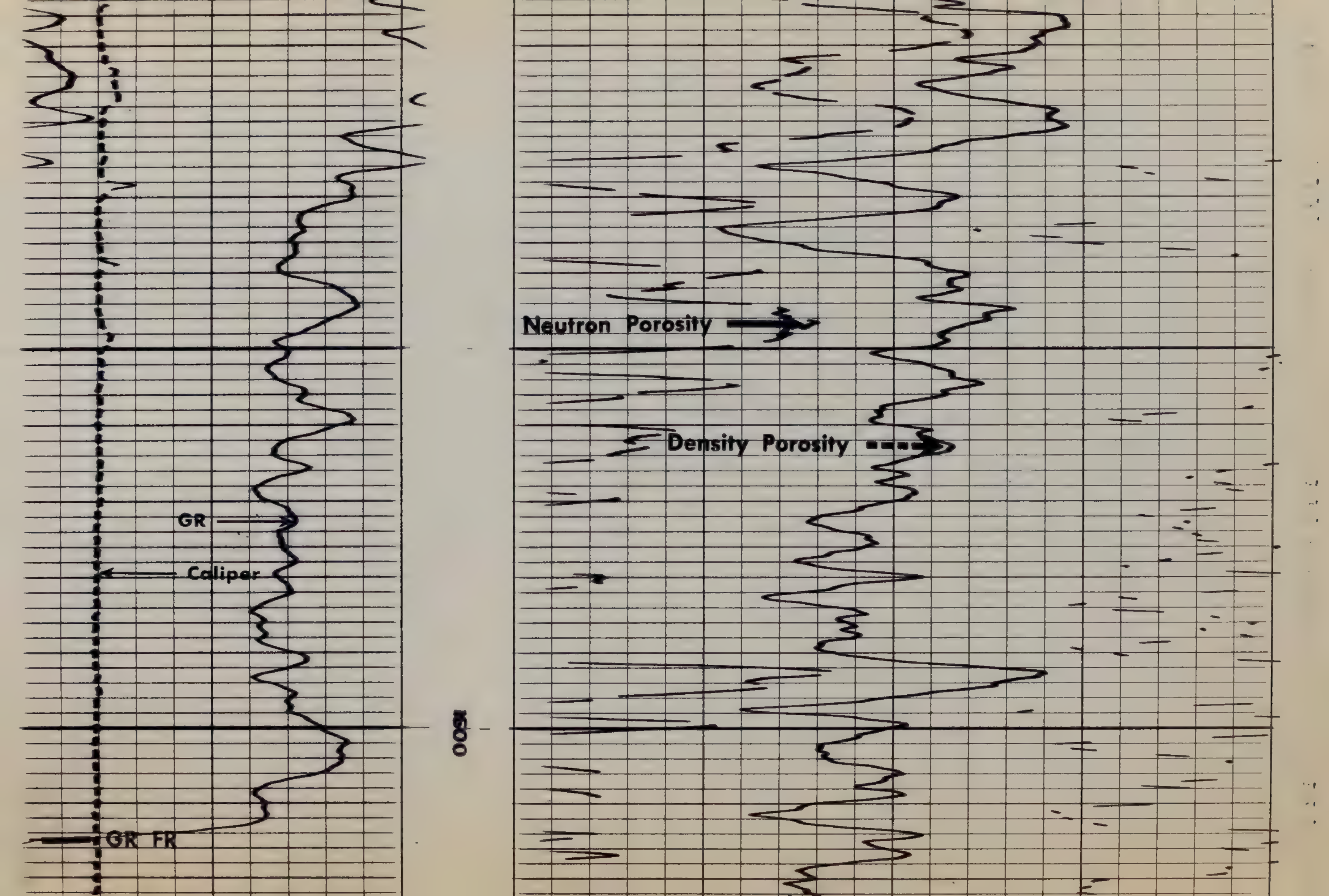
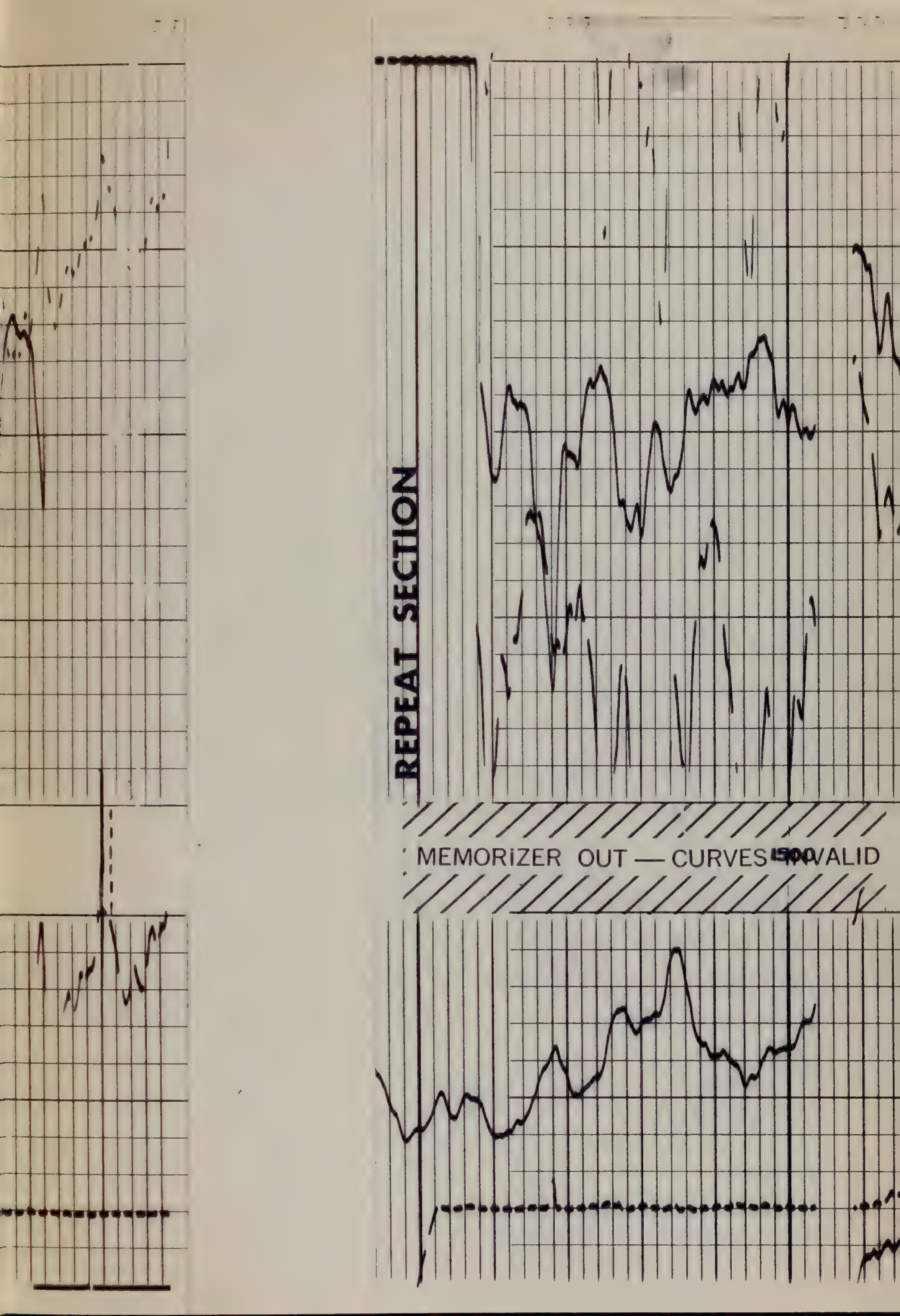
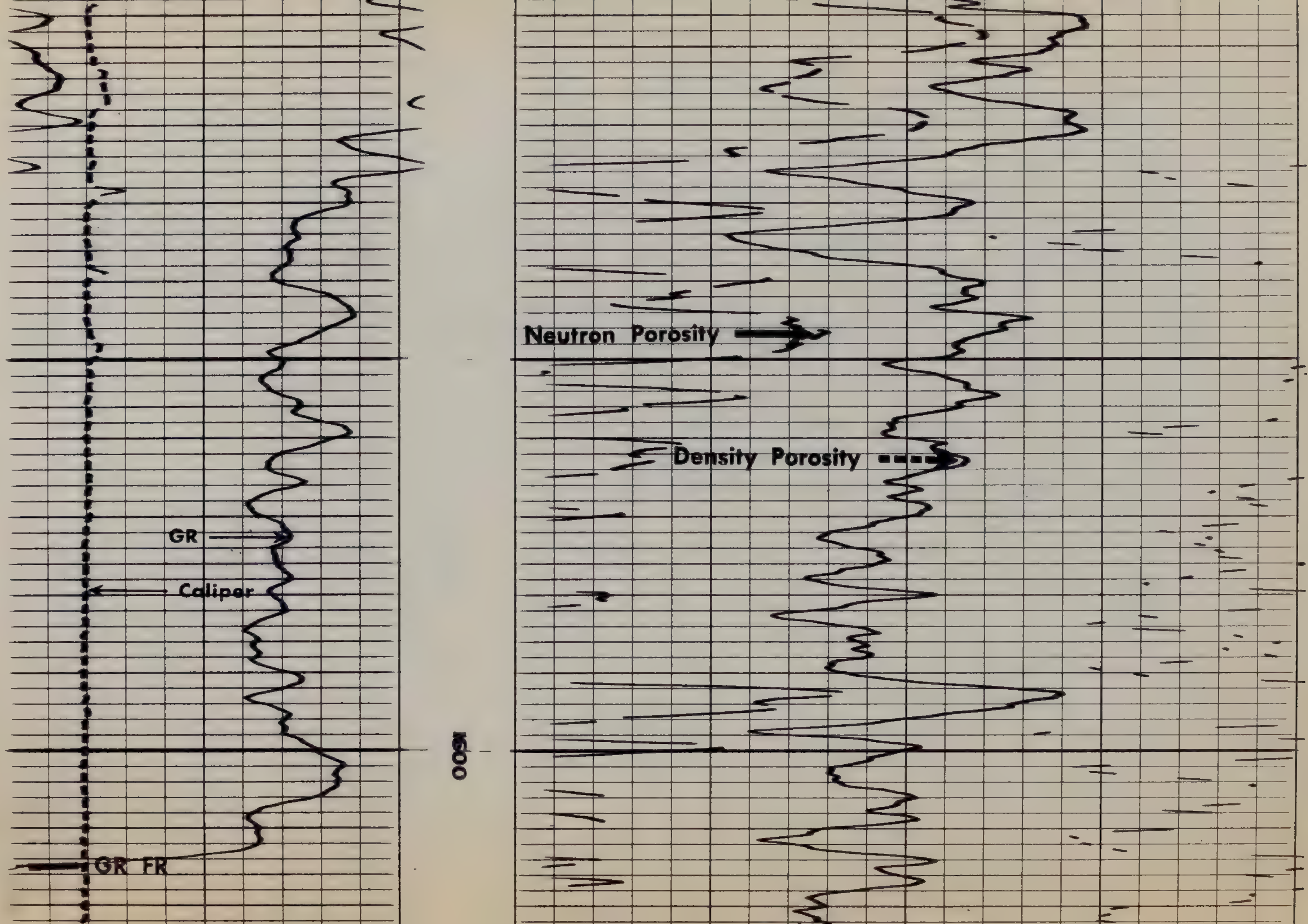
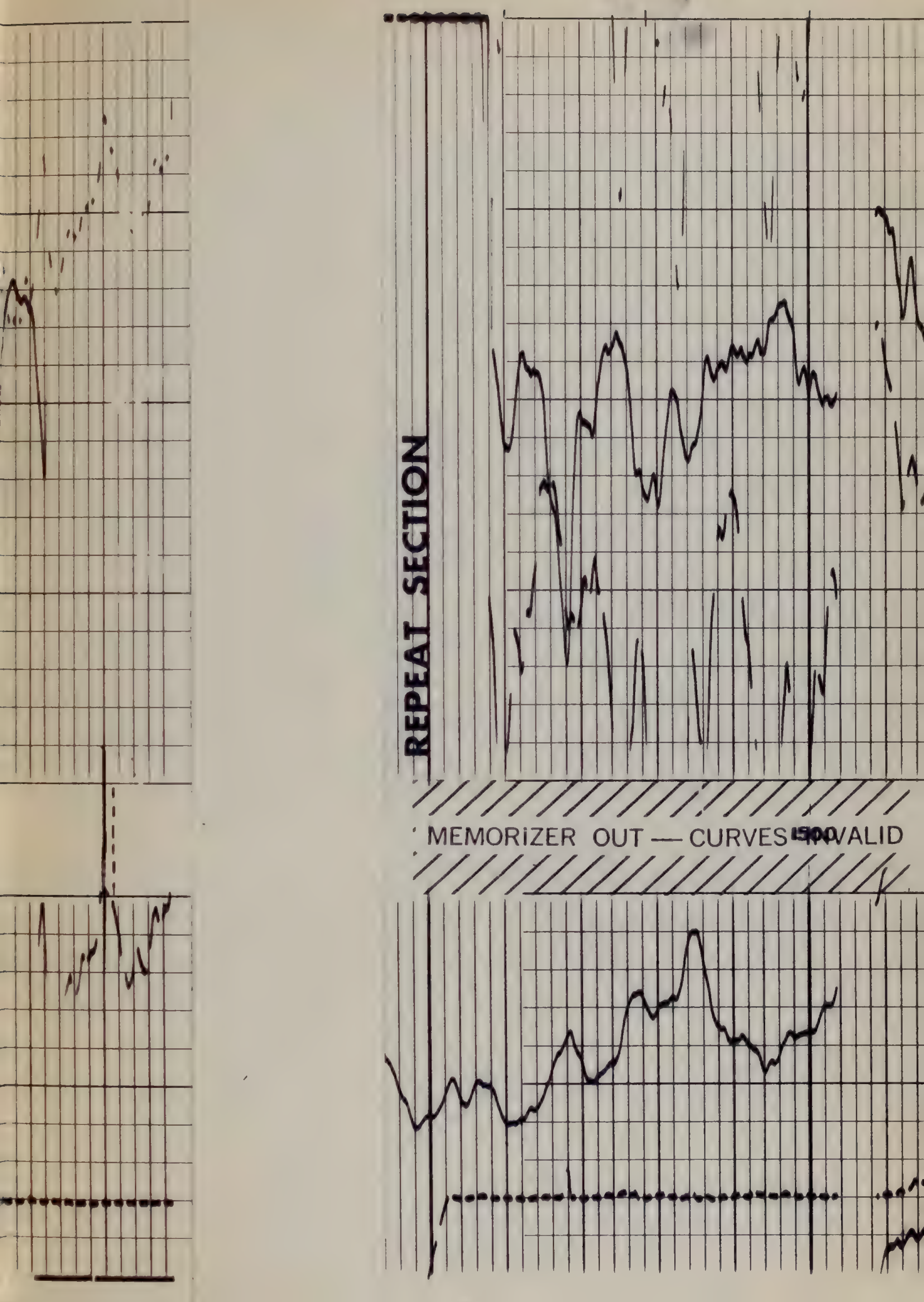
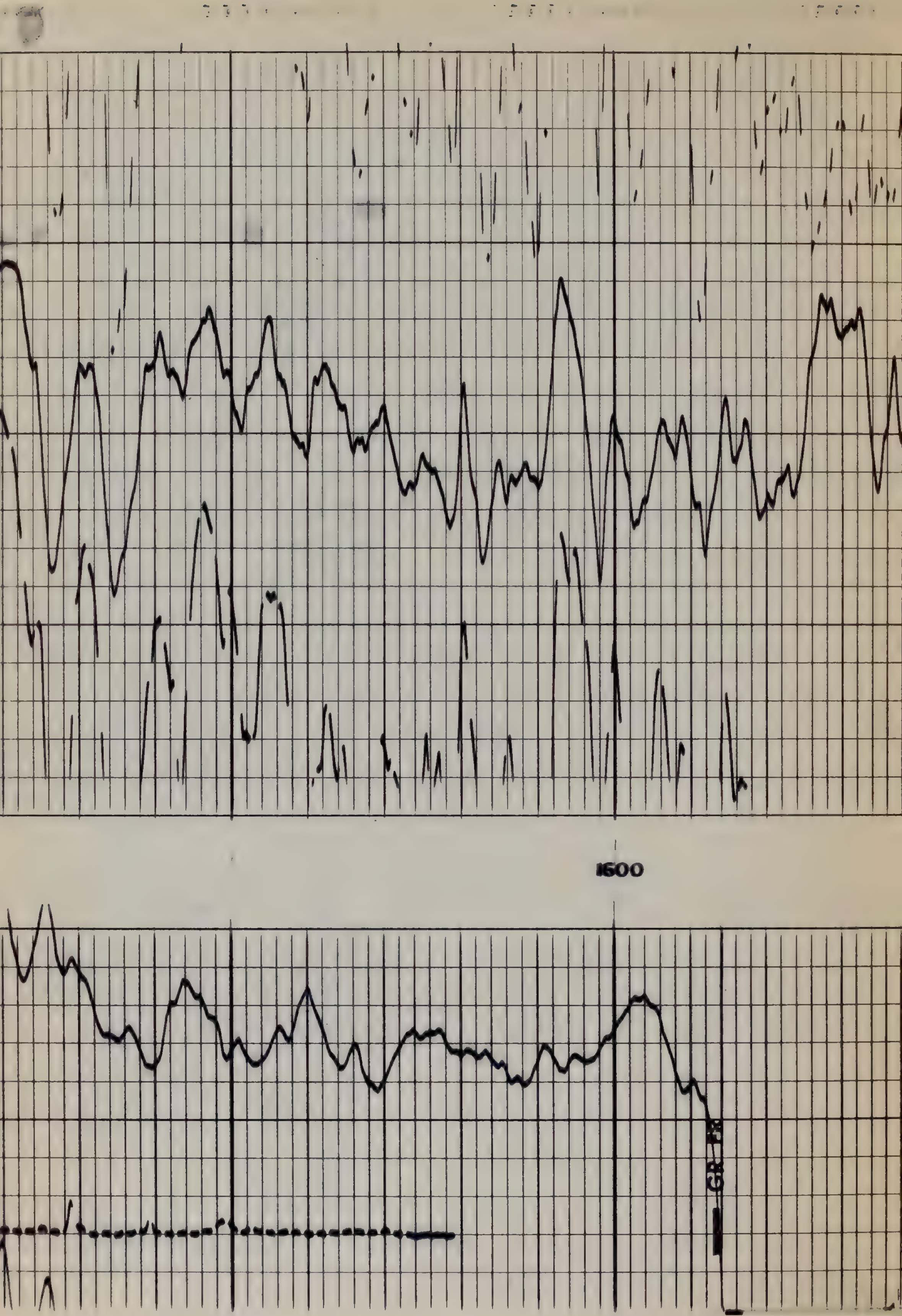

1400
15


GR
Caliper
GR FR
1600
Neutron Porosity
Density Porosity


REPEAT SECTION
MEMORIZER OUT — CURVES INVALID
1500


GR
Caliper
GR FR
1600
Neutron Porosity
Density Porosity


REPEAT SECTION
MEMORIZER OUT — CURVES INVALID
1500


1600
GR
FR

6 16
HOLE DIAM. IN INCHES
CALIPER

0 150

150 300

DENSITY POROSITY INDEX %
LIMESTONE MATRIX

60 45 30 15 0

60 45 30 15 0

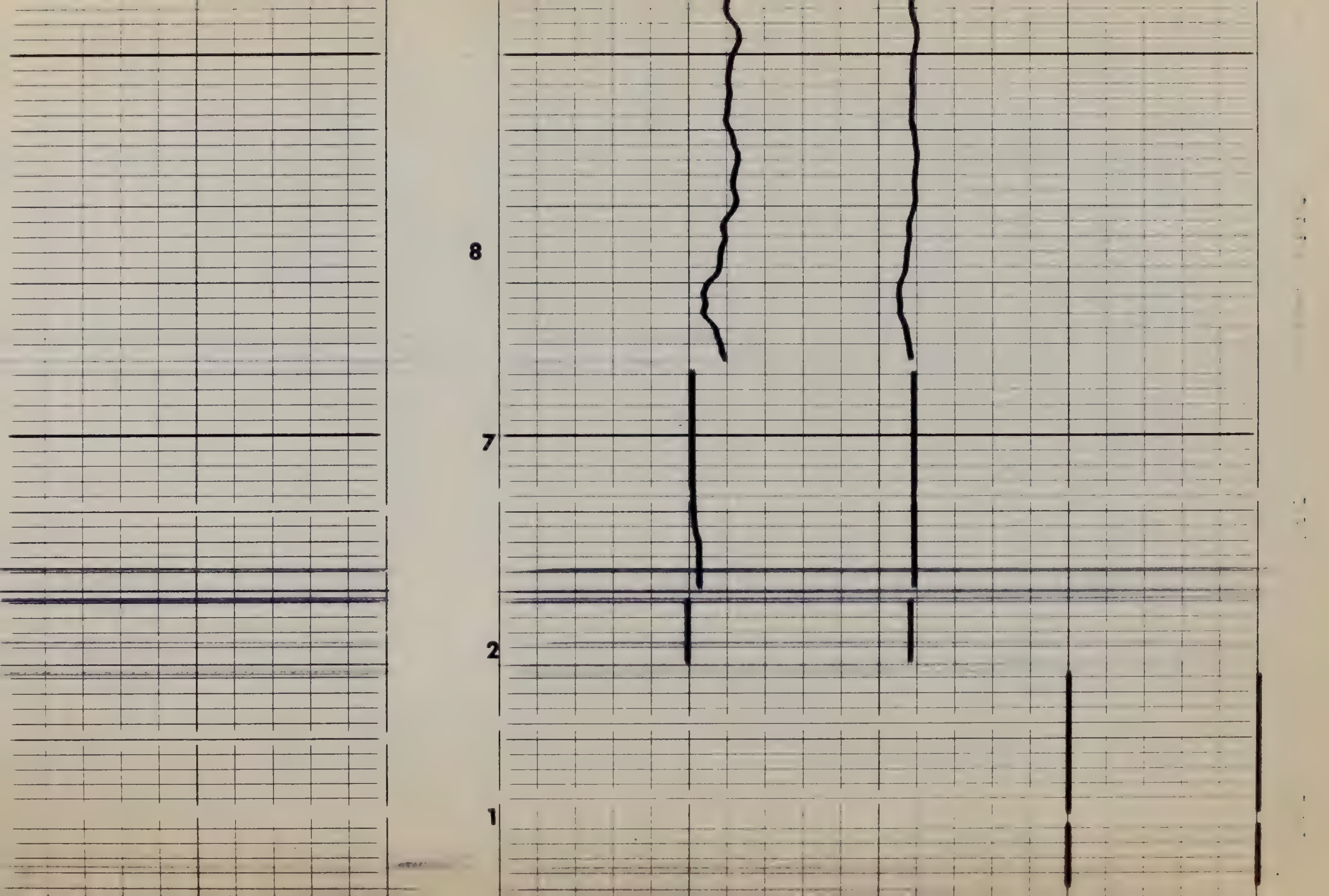
GAMMA RAY
API UNITS

NEUTRON POROSITY INDEX %
LIMESTONE MATRIX

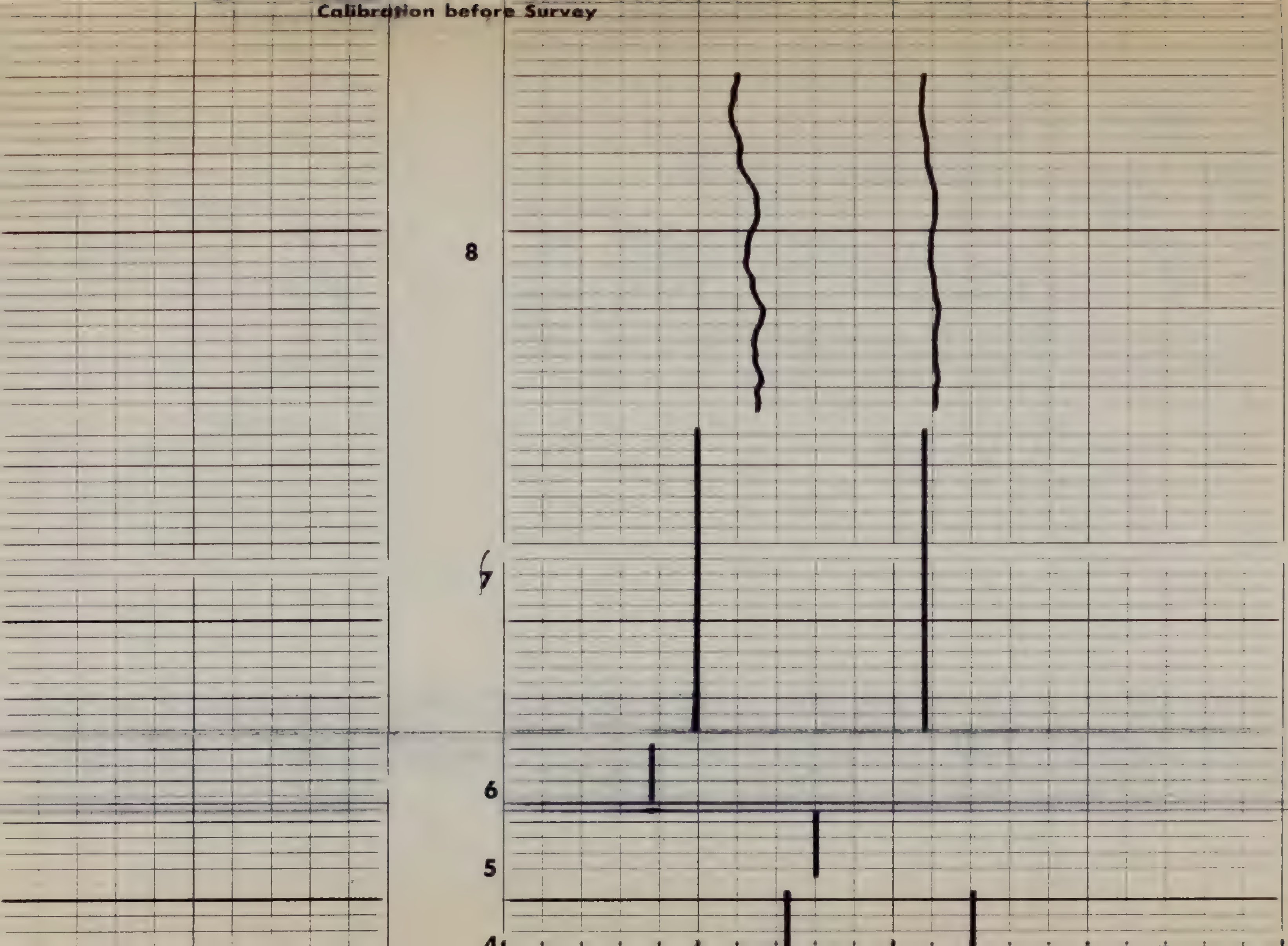
COMPANY THE ATLANTIC RICHFIELD COMPANY
WELL AQUIFER TEST NO. 1-B
FIELD -----
COUNTY RIO BLANCO STATE COLORADO

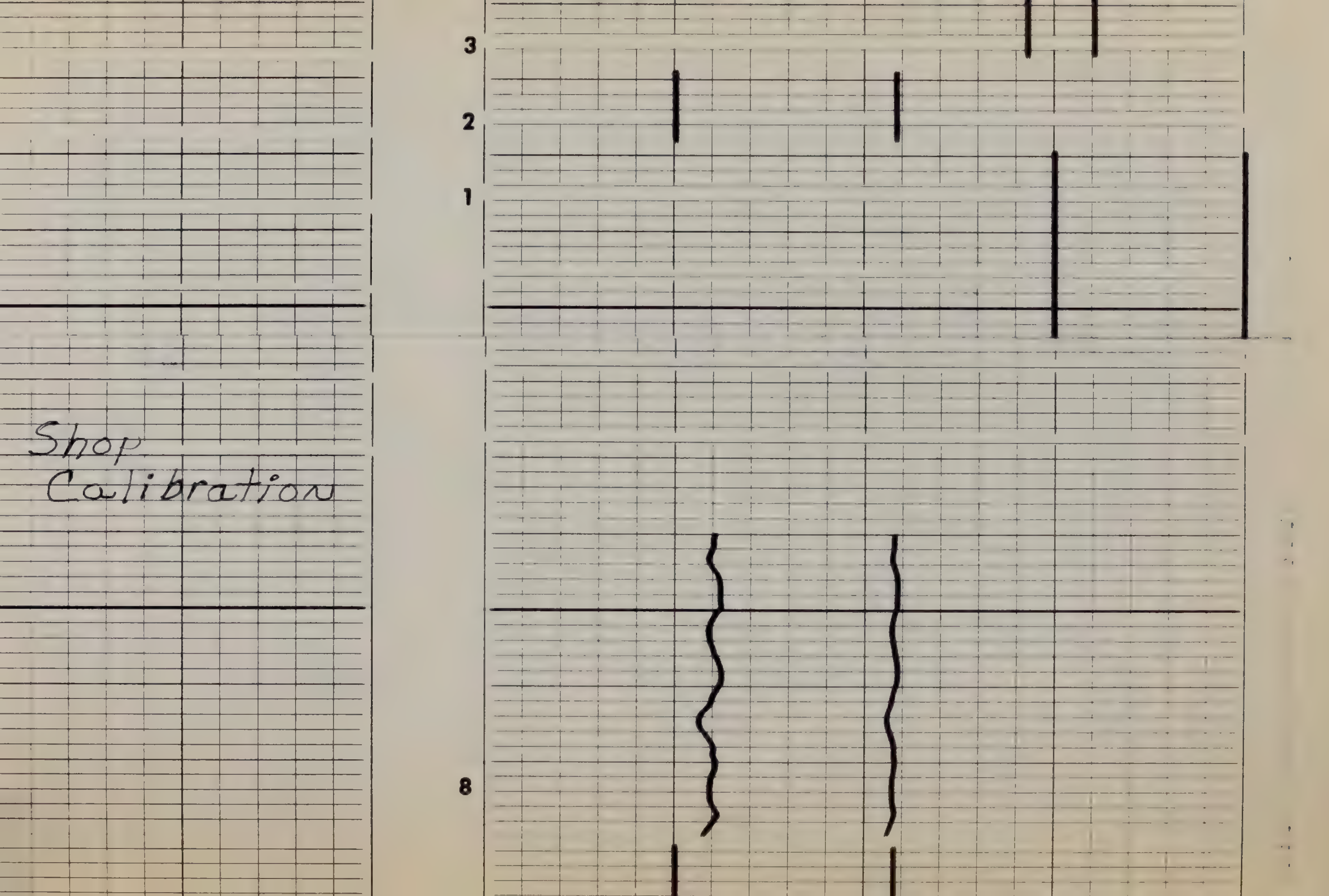
SCHL. FR 1640
SCHL. TD 1641
DRLR TD 1638
Elev:
KB ----
DF ----
GL 6909

CALIBRATION RECORD

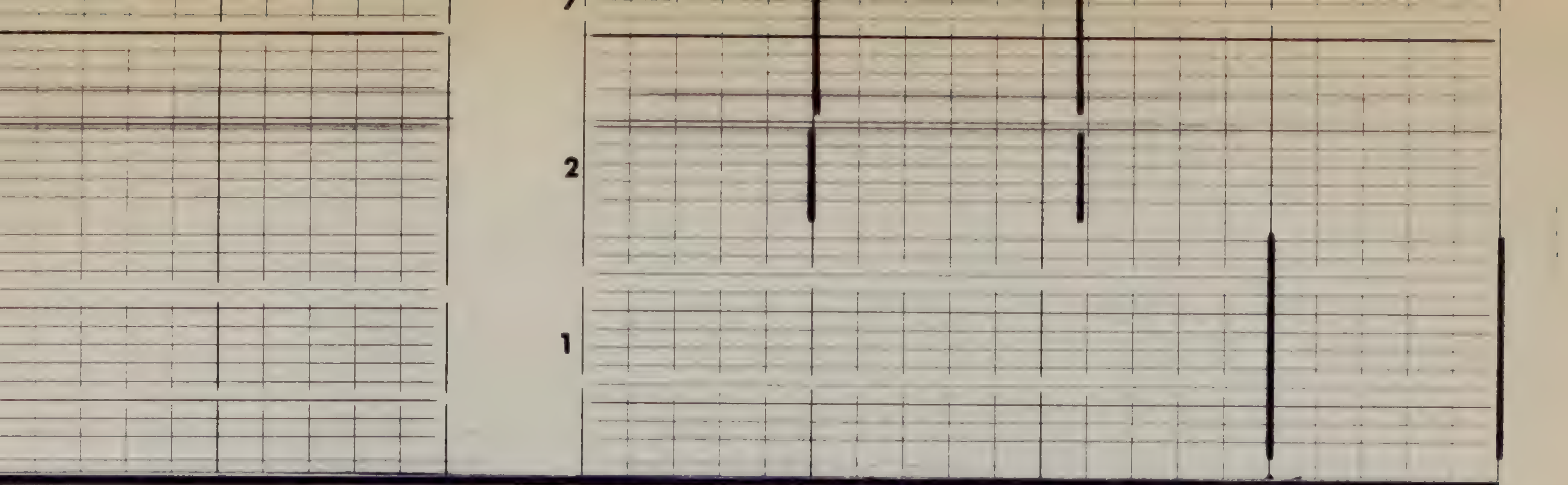

8
7
2
1

Calibration before Survey





Shop
Calibration



COMPENSATED NEUTRON CALIBRATION CODING

1. MECHANICAL ZERO
2. RECORDED SENSITIVITY (THRU MEMORIZER IF USED)

PANEL TEST

	RATIO	OH POROSITY			CH POROSITY	
		LS ☐	SS ☐	DOL ☐	SS ☐	LS ☐
3.	1	1.6	4.9	−0.2	2.4	0.1
4.	2	15.6	19.7	8.1	13.0	9.0
5.	3	31.3	36.0	25.2	29.1	24.1
6.	4	52.2	61.4	53.0	52.2	45.2

7. POROSITY NORMALIZED WITH CNB-A IN PLACE
   7A. TOOL IN NCT-B
8. LOG POSITION WITH CNB-A IN PLACE
   8A. LOG POSITION WITH TOOL IN NCT-B

OH			CH	
LS	SS	DOL	SS	LS
18	22.2	10.4	15.3	11.2

$$\text{RATIO (NORMALIZED)} = \frac{2.17}{\text{RATIO (NCT-B)}}\ \text{RATIO LOG}$$

FORMATION DENSITY COMPENSATED CALIBRATION CODING

1. MECHANICAL ZERO
2. RECORDER SENSITIVITY

PANEL TEST

FDC LIQUID

	POS	ρ	$\triangle\rho$
3.	# 1	2.92	.00
4.	# 2	2.78	+.14
5.	# 3	2.42	−.10
6.	# 4	2.35	.00
7.	# 5	2.08	.01

8. MECHANICAL ZERO CALIPER
9. 8" RING
10. 12" RING
11. TOOL CALIBRATE #1 SET $\rho = 2.50$
12. TOOL CALIBRATE #2 SET $\triangle\rho = .00$
13. LOG POSITION $\rho = 2.59$, $\triangle\rho = .015$

CALIBRATION RECORD

COMPANY THE ATLANTIC RICHFIELD COMPANY
WELL AQUIFER TEST NO. 1-B
FIELD -----
COUNTY RIO BLANCO STATE COLORADO

SCHL. FR 1640
SCHL. TD 1641
DRLR TD 1638
Elev:
KB ----
DF ----
GL 6909

VS-1938-B

ENGINEERED PRODUCTION LOGGING

Schlumberger

COMPANY THE ATLANTIC RICHFIELD COMPANY

WELL AQUIFER TEST NO. 1-B

FIELD ----

COUNTY RIO BLANCO STATE COLORADO

LOCATION:

Sec. 7 Twp. 3S Rge. 96W

SERVICES RUN:
DIL
FDC-GR
CNL-GR
BHC-GR

Permanent Datum: GL

Elev.: 6909

Log Measured From: GL

Drilling Measured From: GL

ELEVATION:
KB
DF ----
GL 6909

Equipment Location: 5602-GRAND JUNCTION

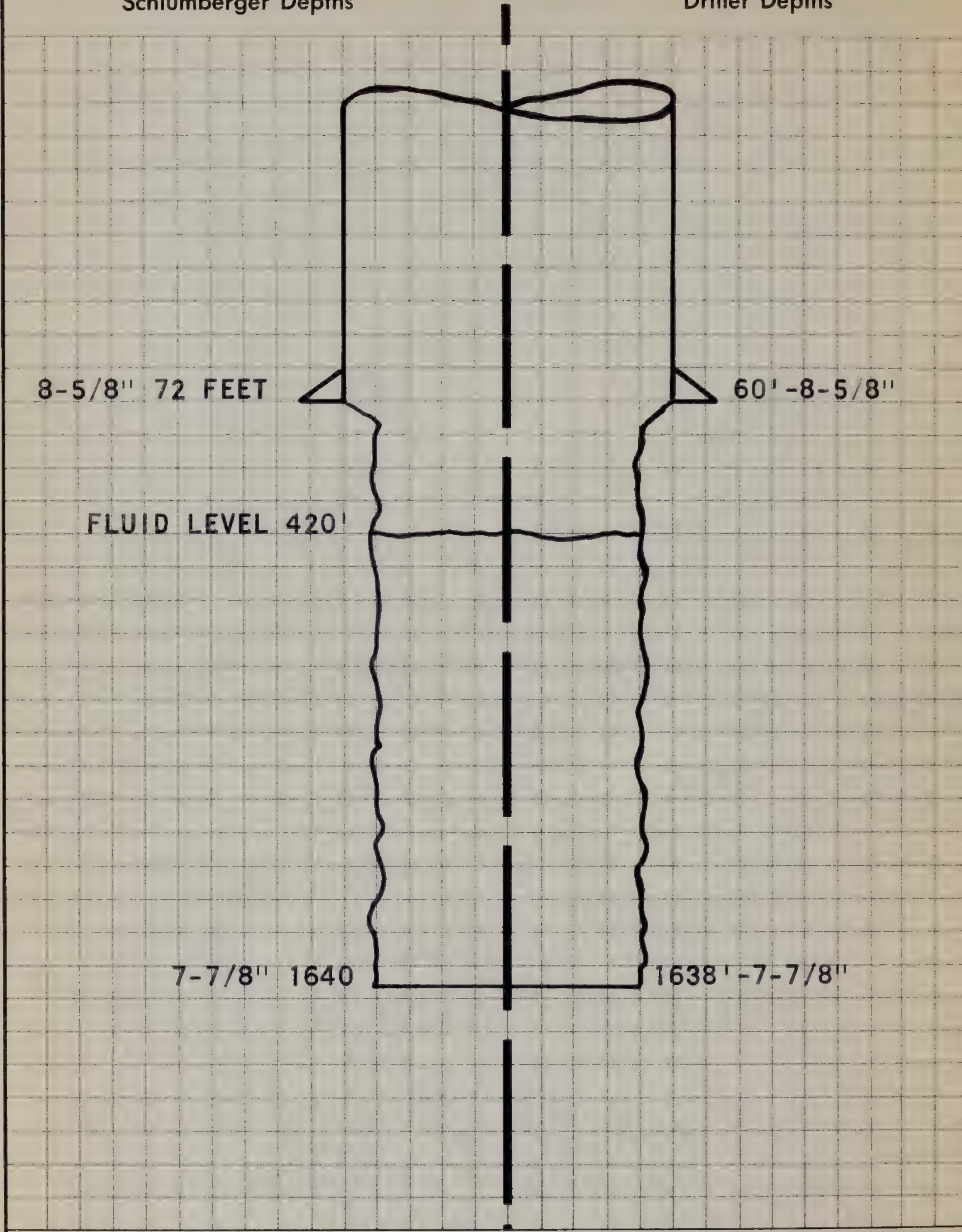
Recorded by: SCHNORR DATE: 7-21-74

Witnessed by: TAIT

SWS-1424-C

Log depths of these records relate to: ☒ Schlumberger line measurements,
☐ correlated by CCL to Radioactivity Log Measurements.

Schlumberger Depths WELL SKETCH Driller Depths


8-5/8" 72 FEET
60'-8-5/8"
FLUID LEVEL 420'
7-7/8" 1640
1638'-7-7/8"

Indicate:
- Hole deviation in production zone
- Open hole diameter
- Diameter and weight of casing and tubing
- Position & nature of perforations (bullets, conventional SC, capsules, etc.)

The well name, location and borehole reference data were furnished by the customer.

FOLD HERE

Schlumberger

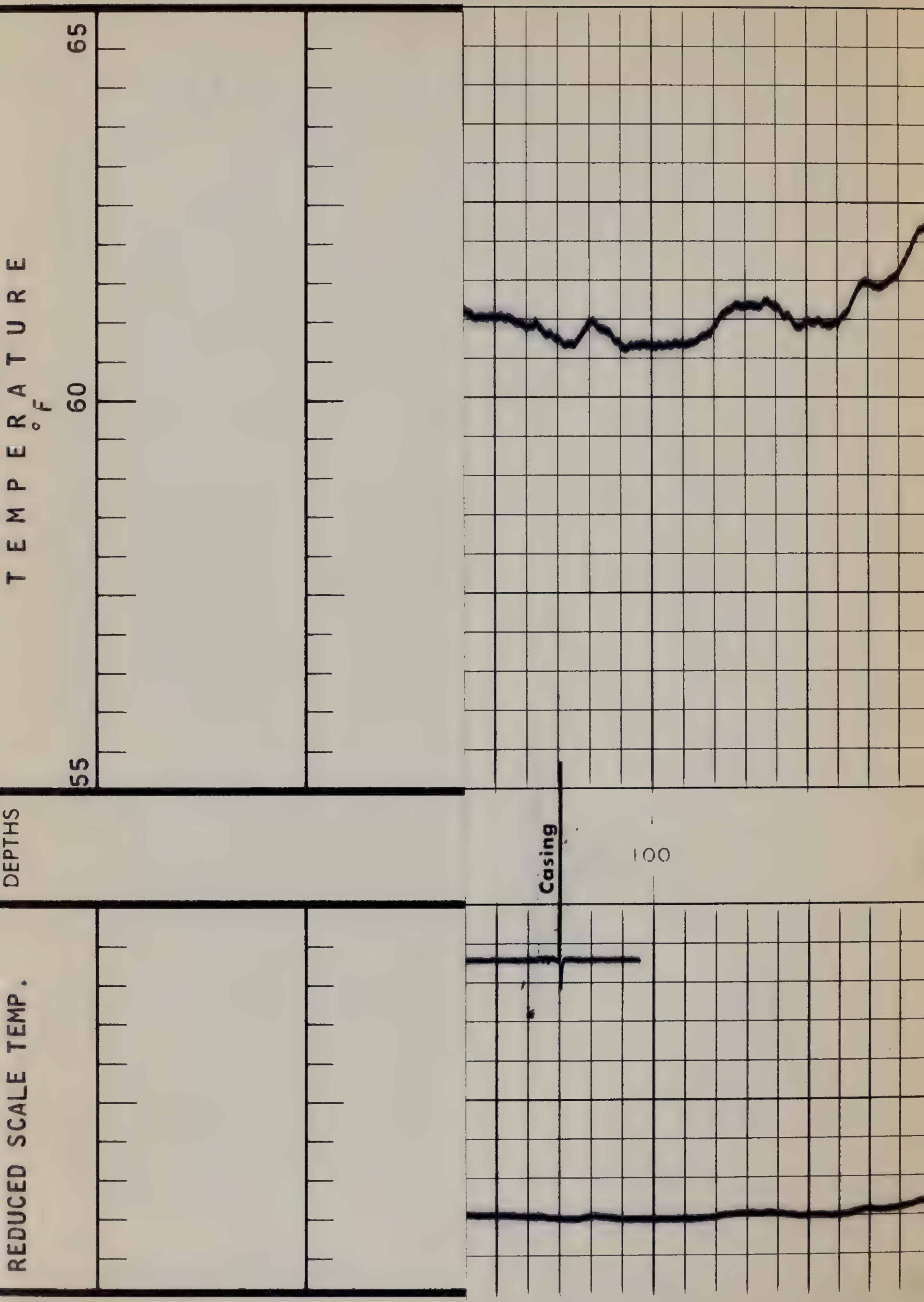
TEMPERATURE

	RUN # 1	RUN #	RUN #	RUN #	RUN #
	PASS # 1	PASS #	PASS #	PASS #	PASS #
Date	7-21-74				
Production Method	STATIC				
Stabil. time before log	12 HRS.				
Hours log began	01:00				
Bottom logged interval	1637				
Top logged interval	40				
Film logged "UP" or "DOWN"	DOWN				
THP Static psi	----				
THP Dynamic psi	----				
BHP Static psi	----				
BHP Dynamic psi	----				
Well head temp. °F	61				
Surf. Prod. Rate	----				
Surf. Injection Rate	----				

SURFACE EQUIPMENT		DOWNHOLE EQUIPMENT		
PPU A-777K	TEP	CEC	FAC	CCL
PRU	GNP	CCE	FAA	GNT-K
PCU	ETU	MTS	HUM	SGT-G
HTU A-730	CFP	GMS	SSA	ETC
GMU		TCS	PSA	ETS
CFU		FBS	MSA	PAC-A
CMU		CFS	TEE	HTS-B 787
FAU		PRC	TEC	TTC

FLOWMETER	CFS	SSA FAA	FBS
Spinner Size			
Spinner Pitch			

REMARKS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DEPTHS
Casing
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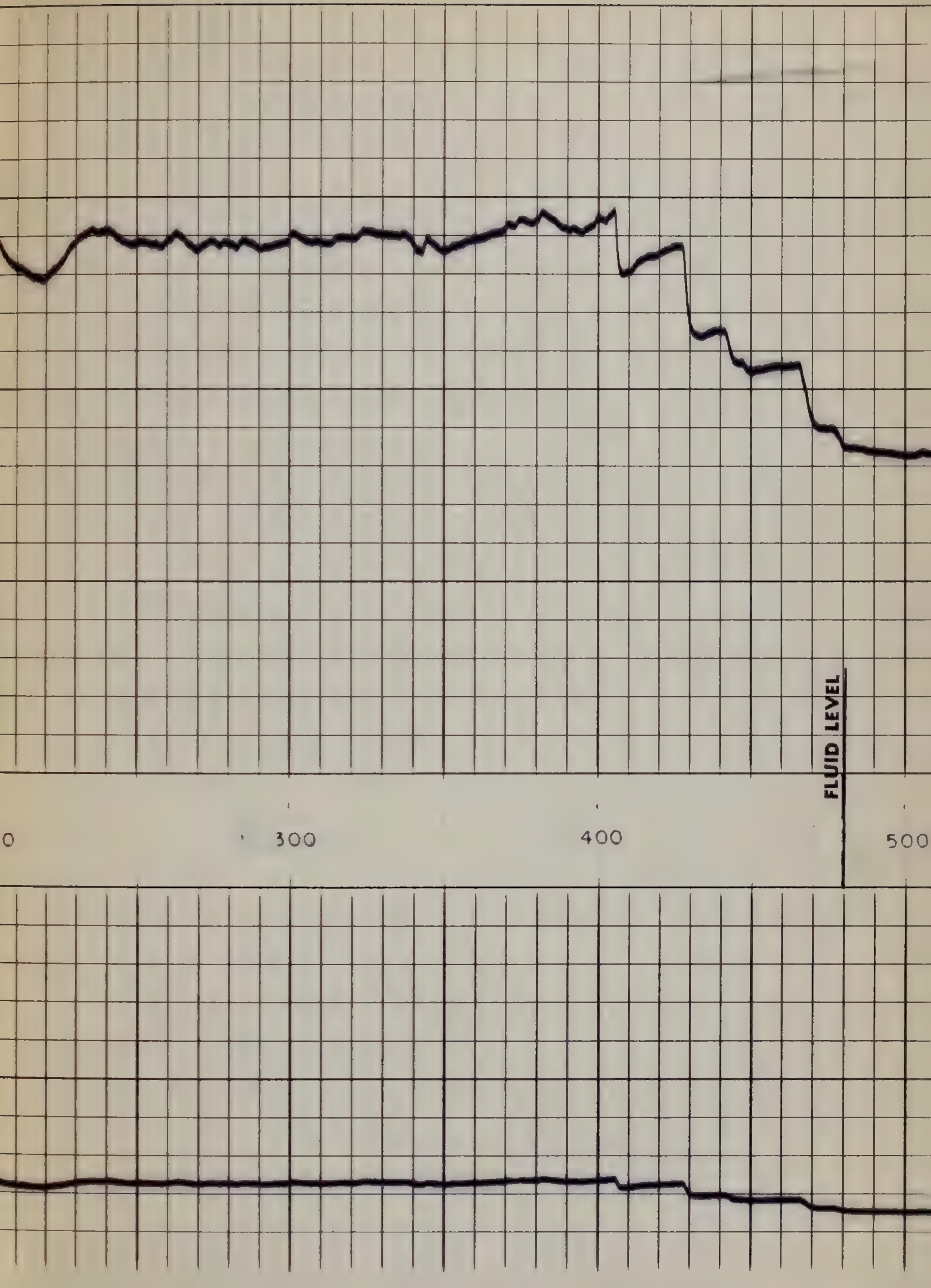
REDUCED SCALE TEMP.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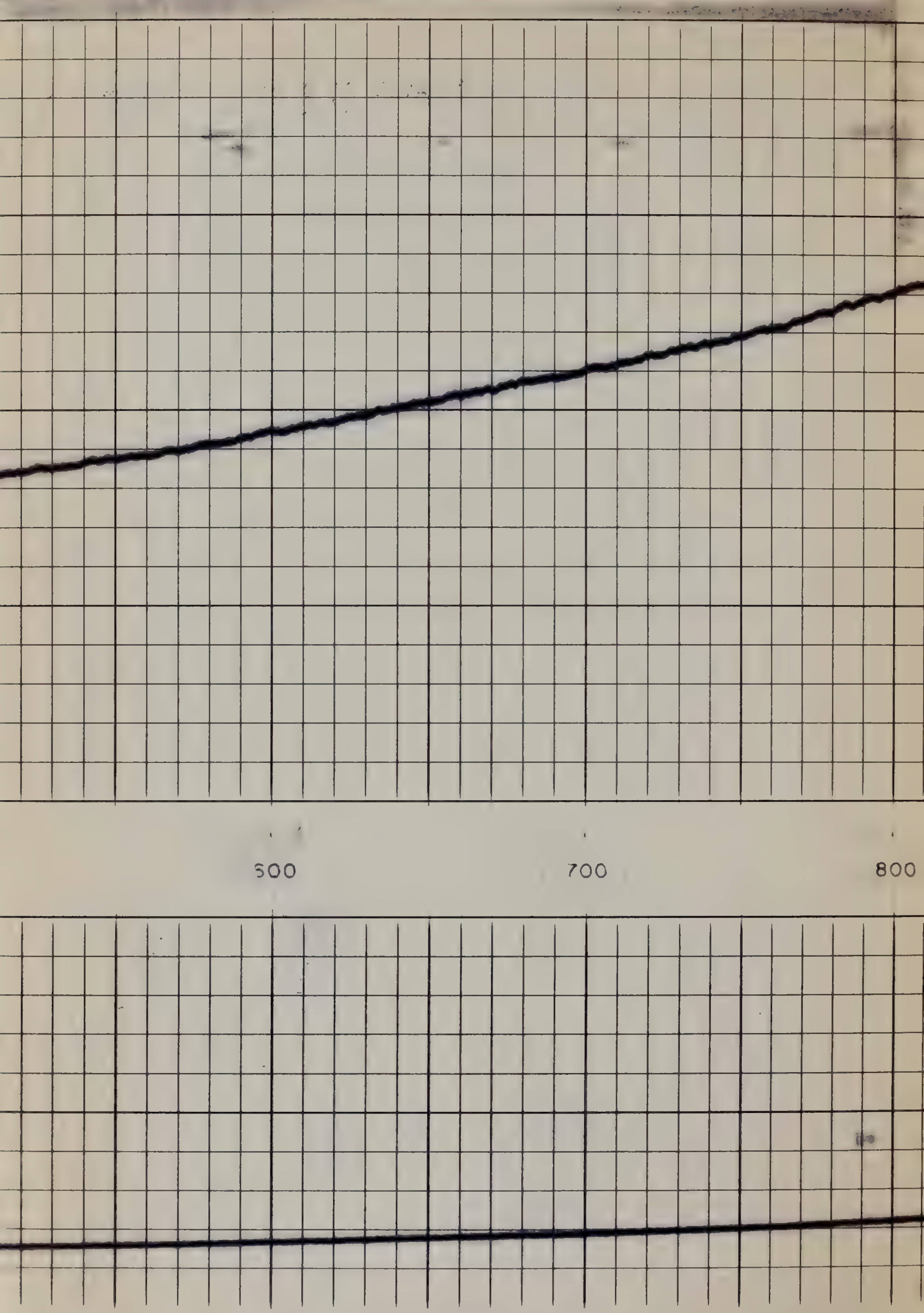
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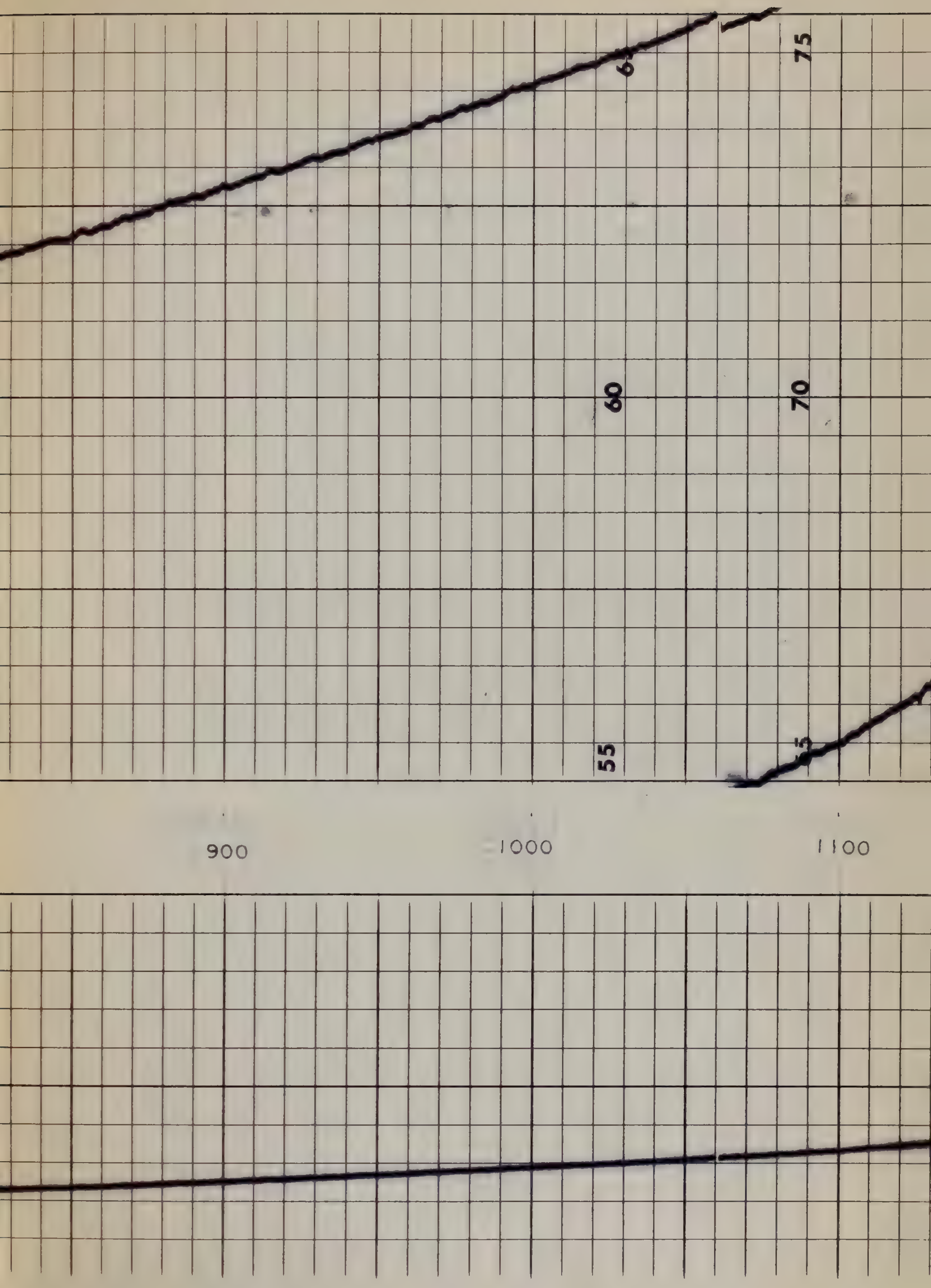
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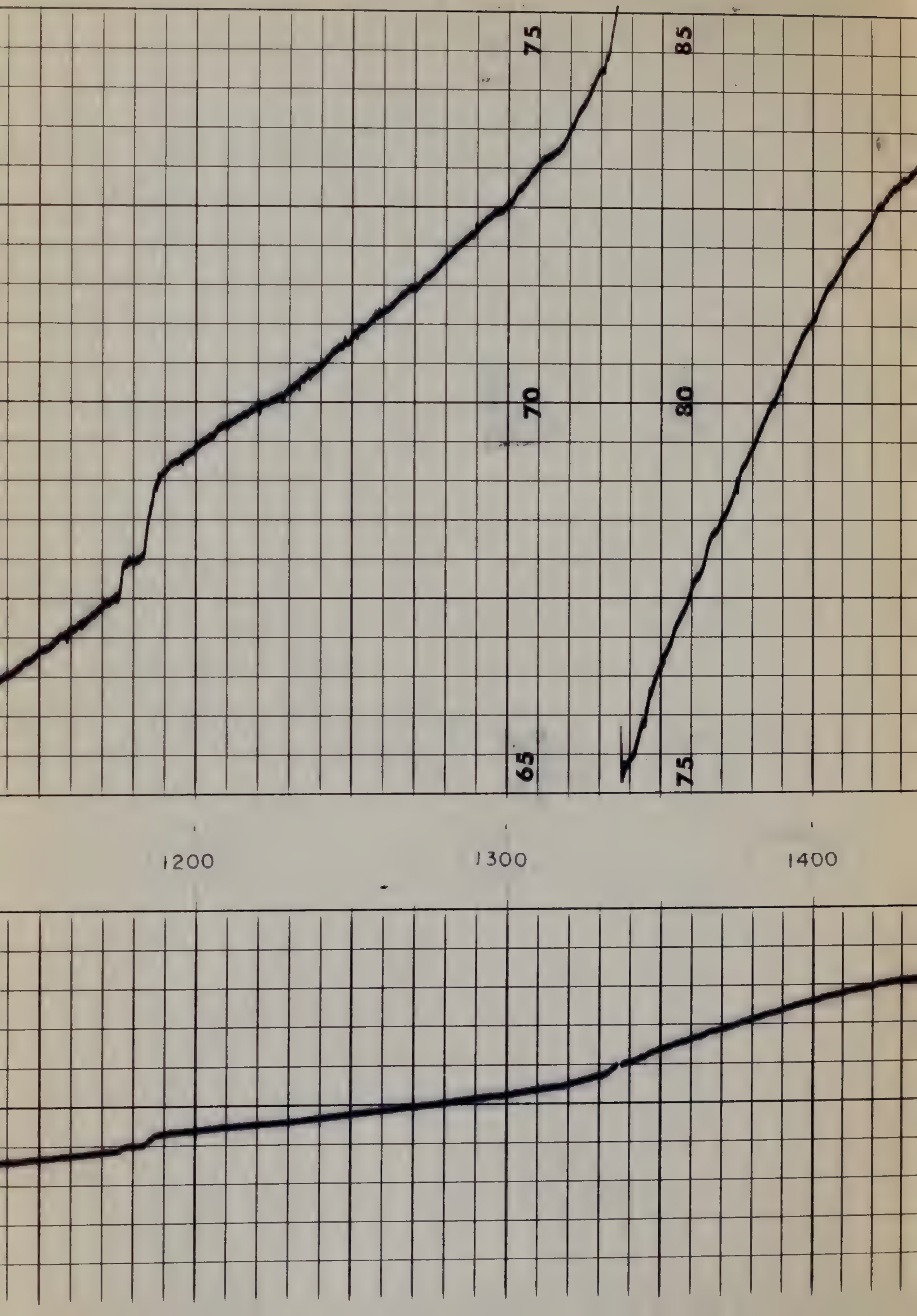
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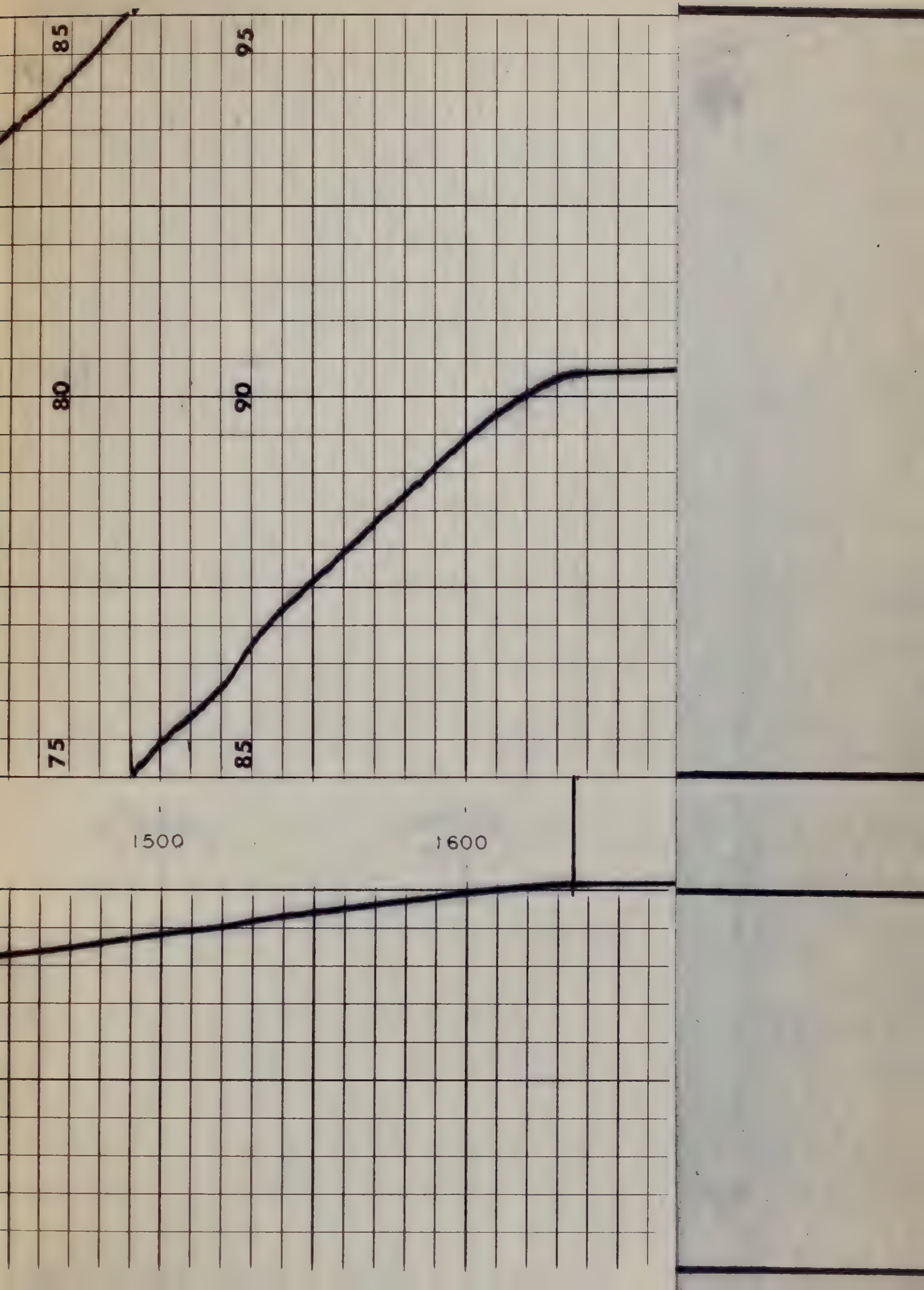
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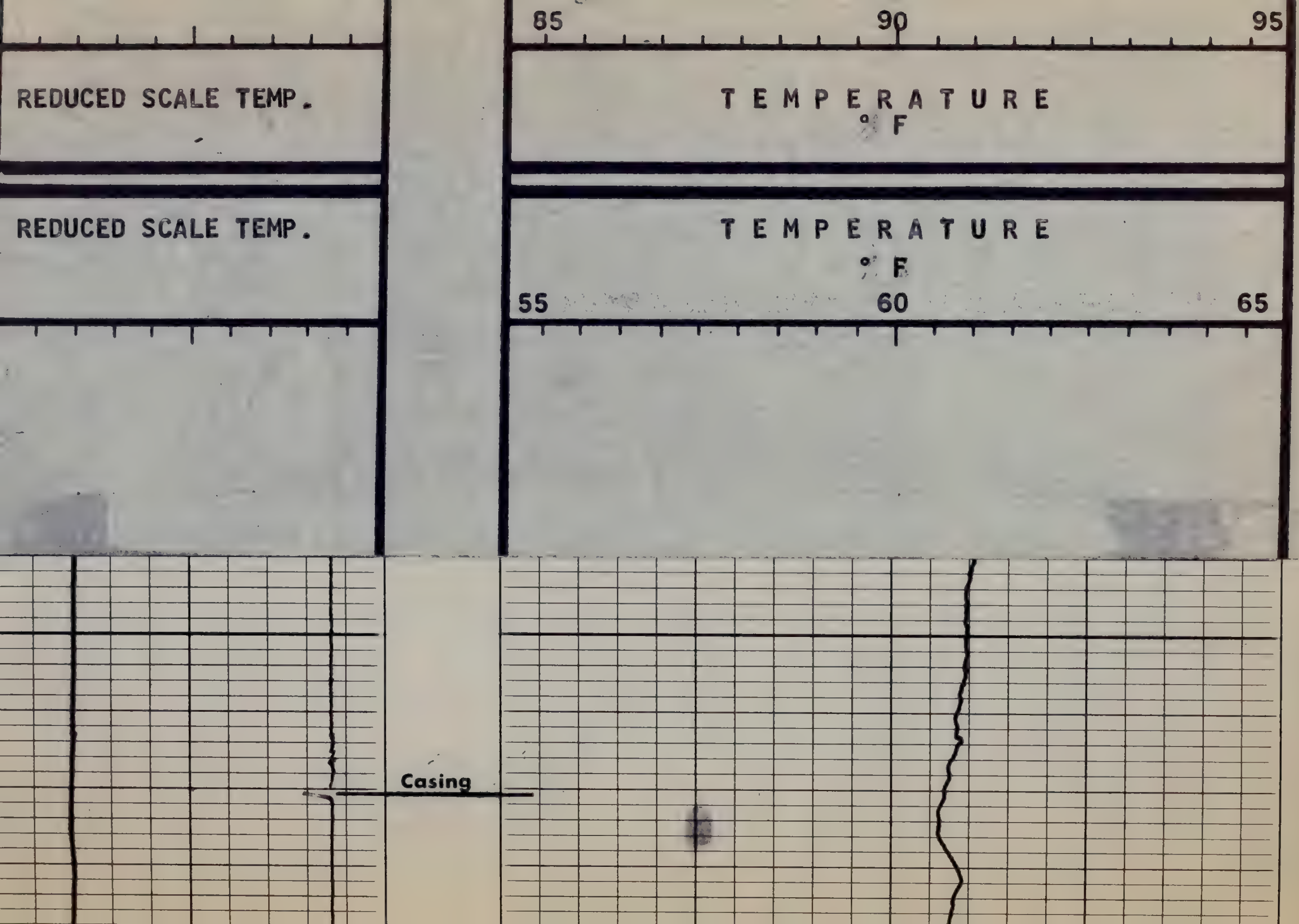
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REDUCED SCALE TEMP.
TEMPERATURE
°F
REDUCED SCALE TEMP.
TEMPERATURE
°F
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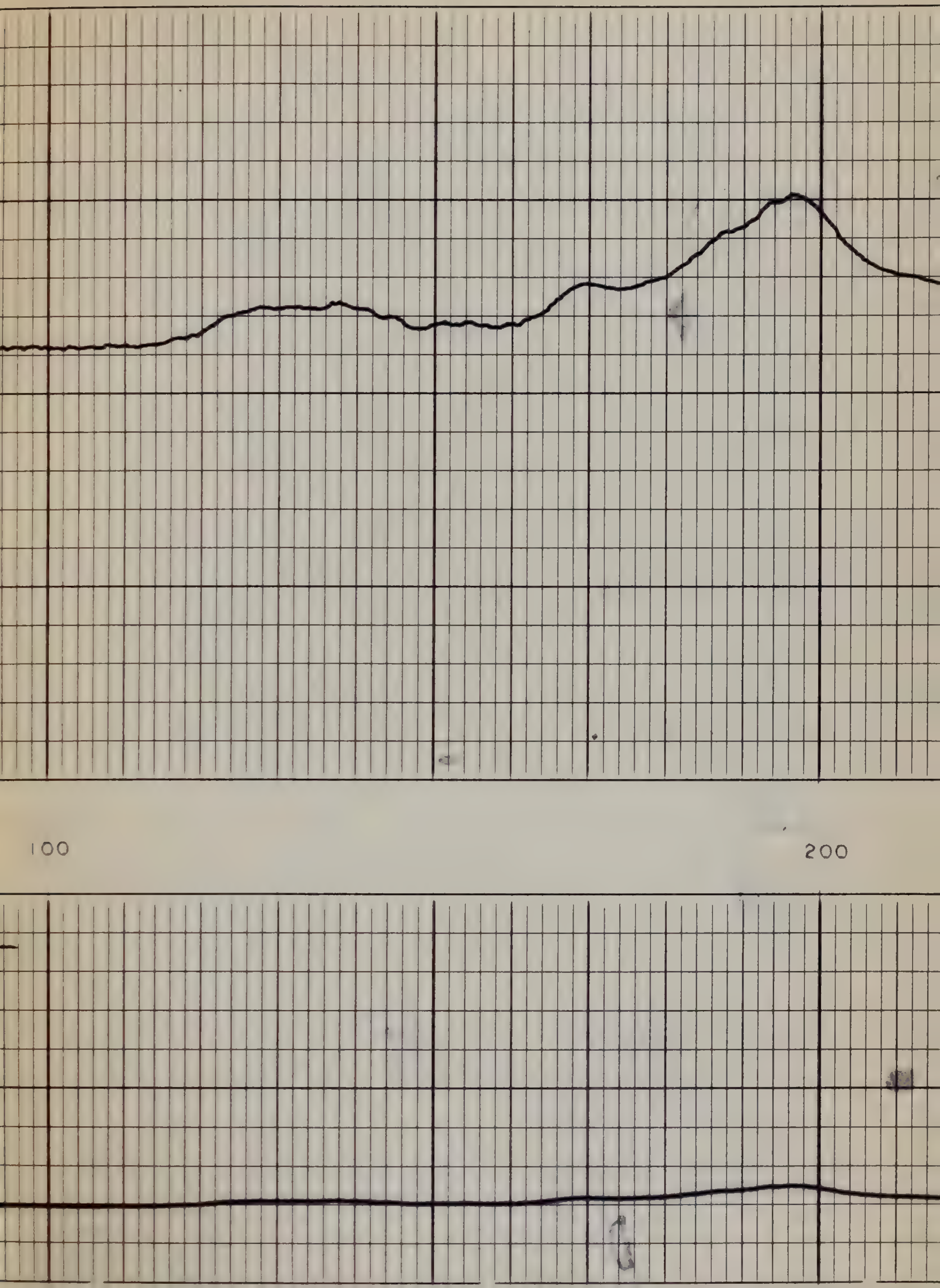
Casing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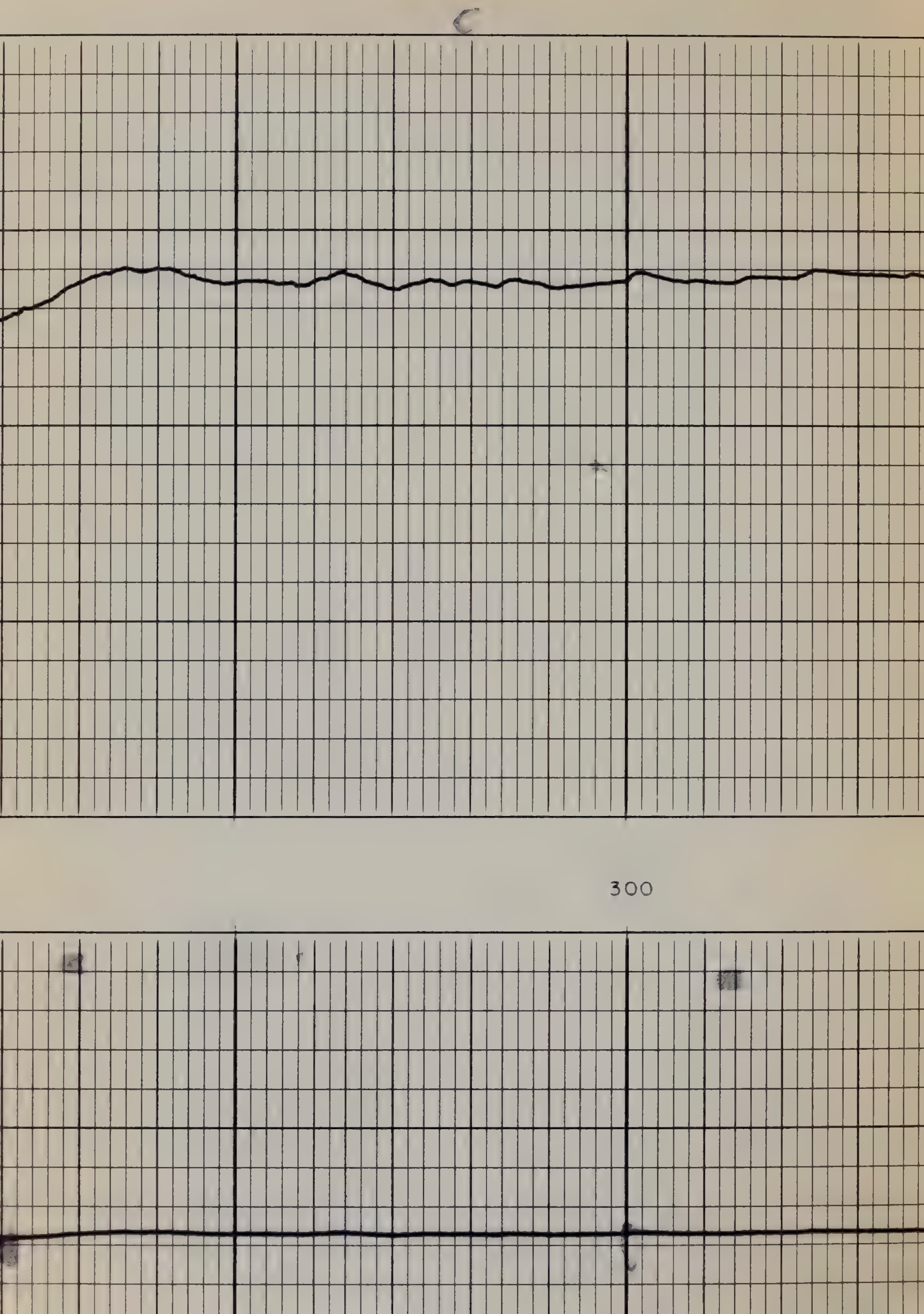
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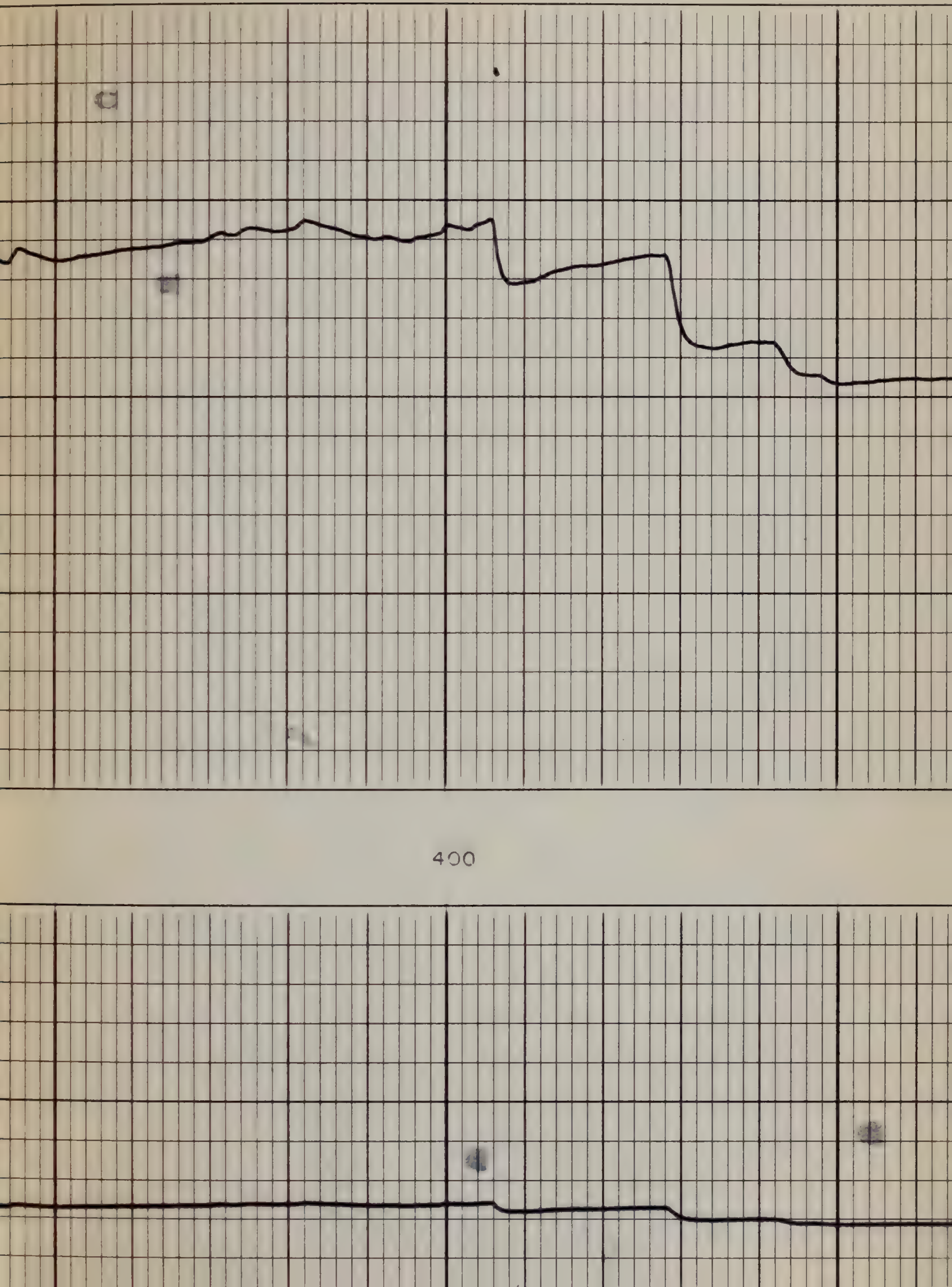
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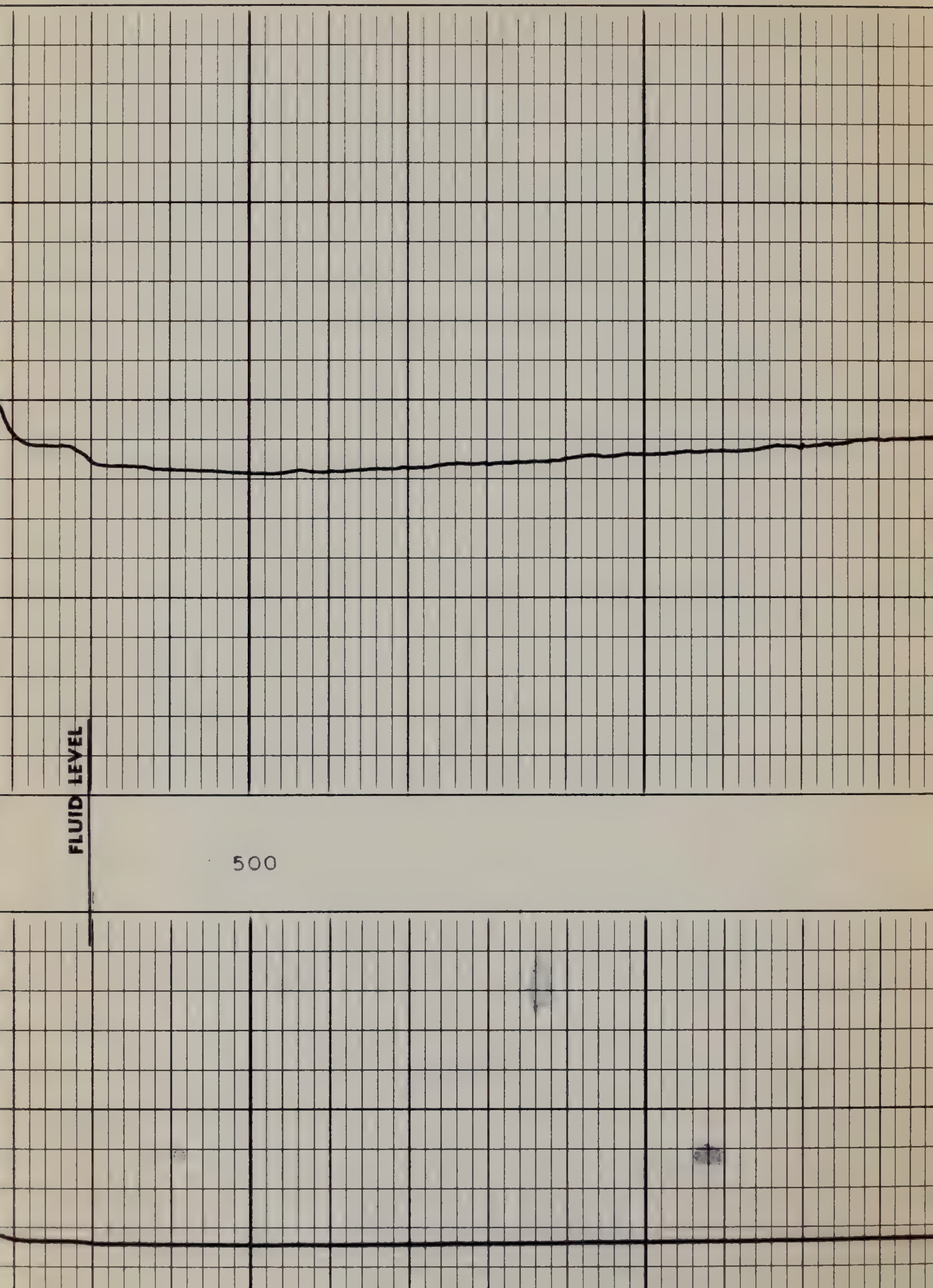
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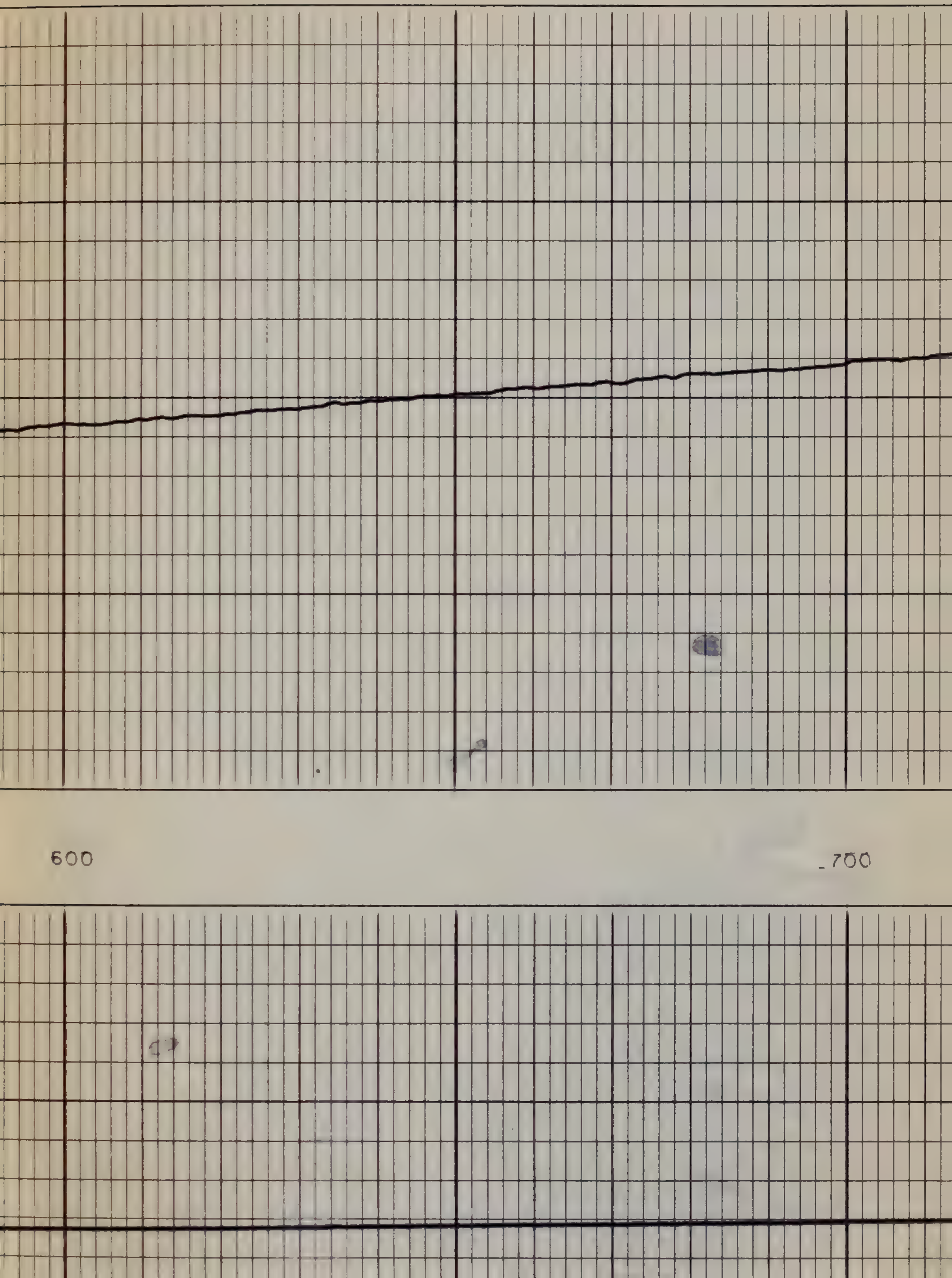
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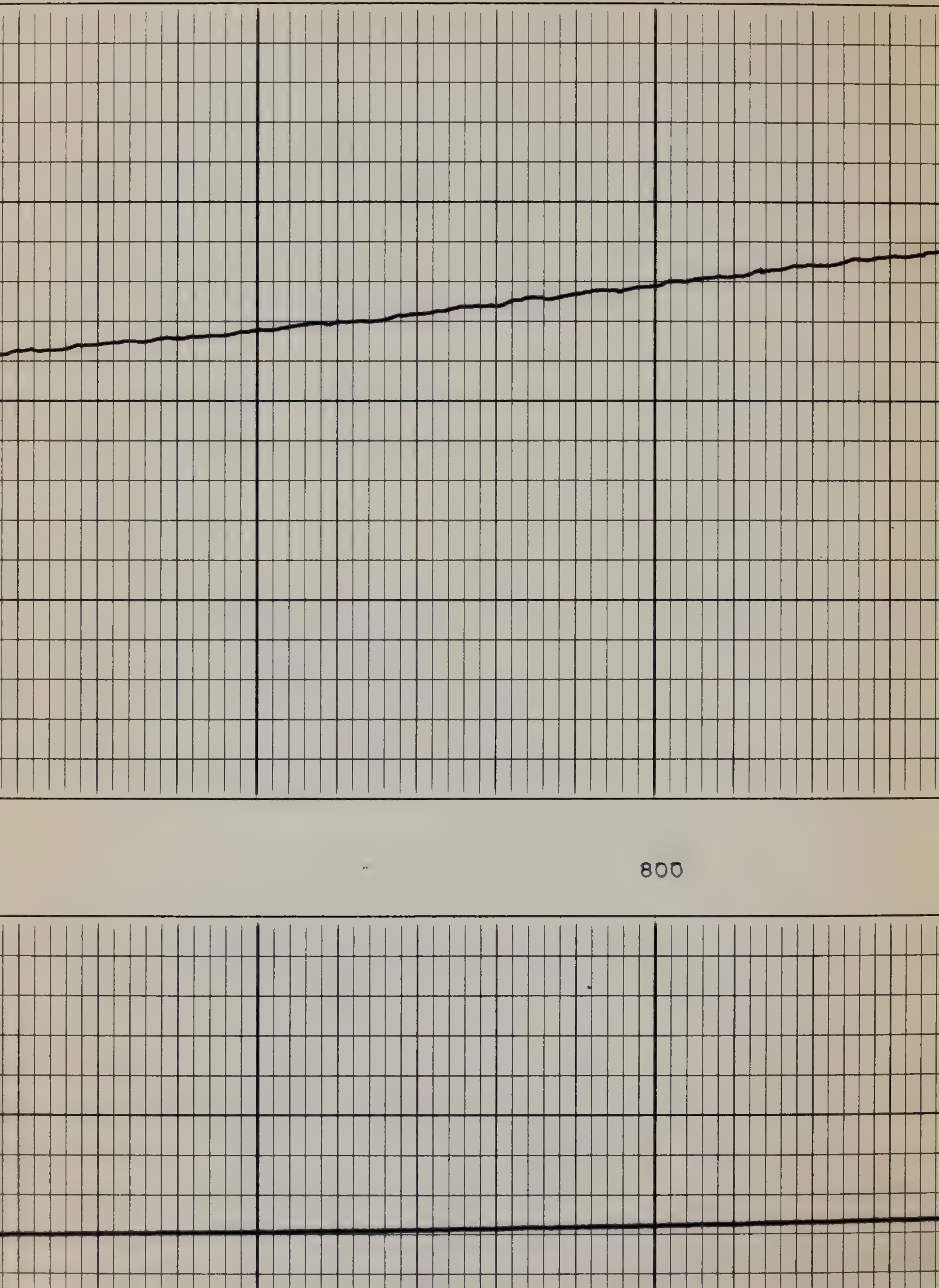
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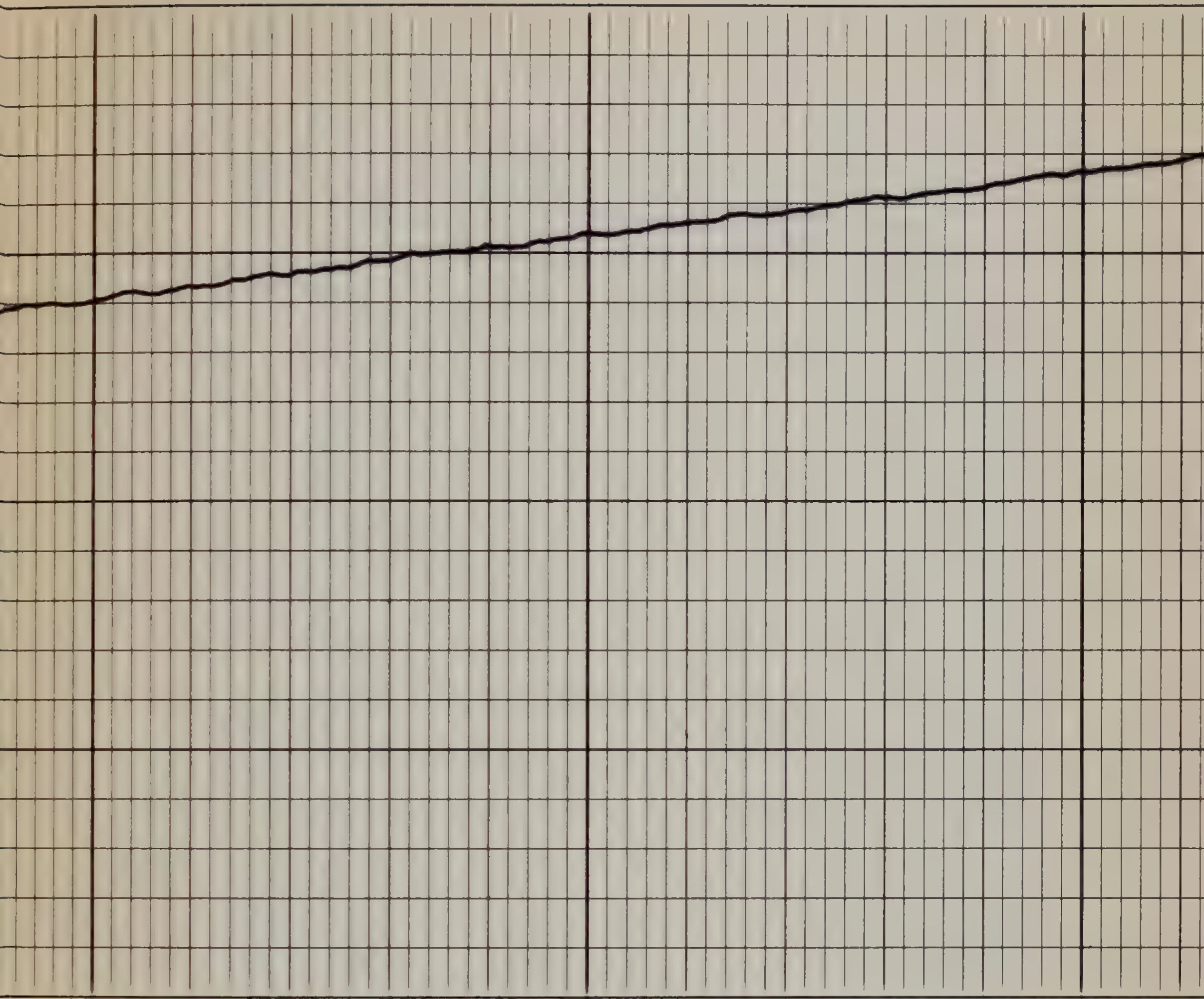

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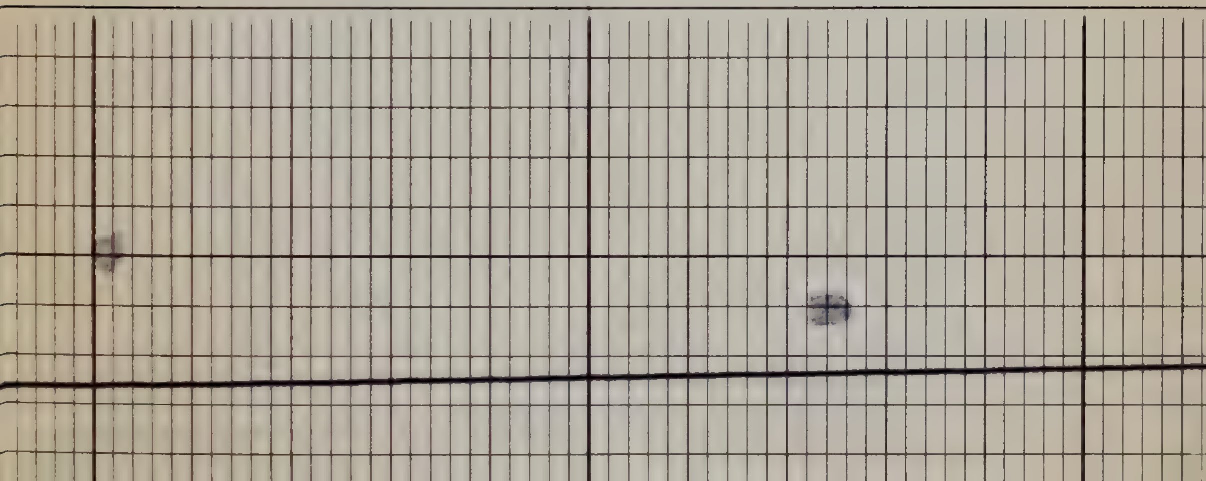

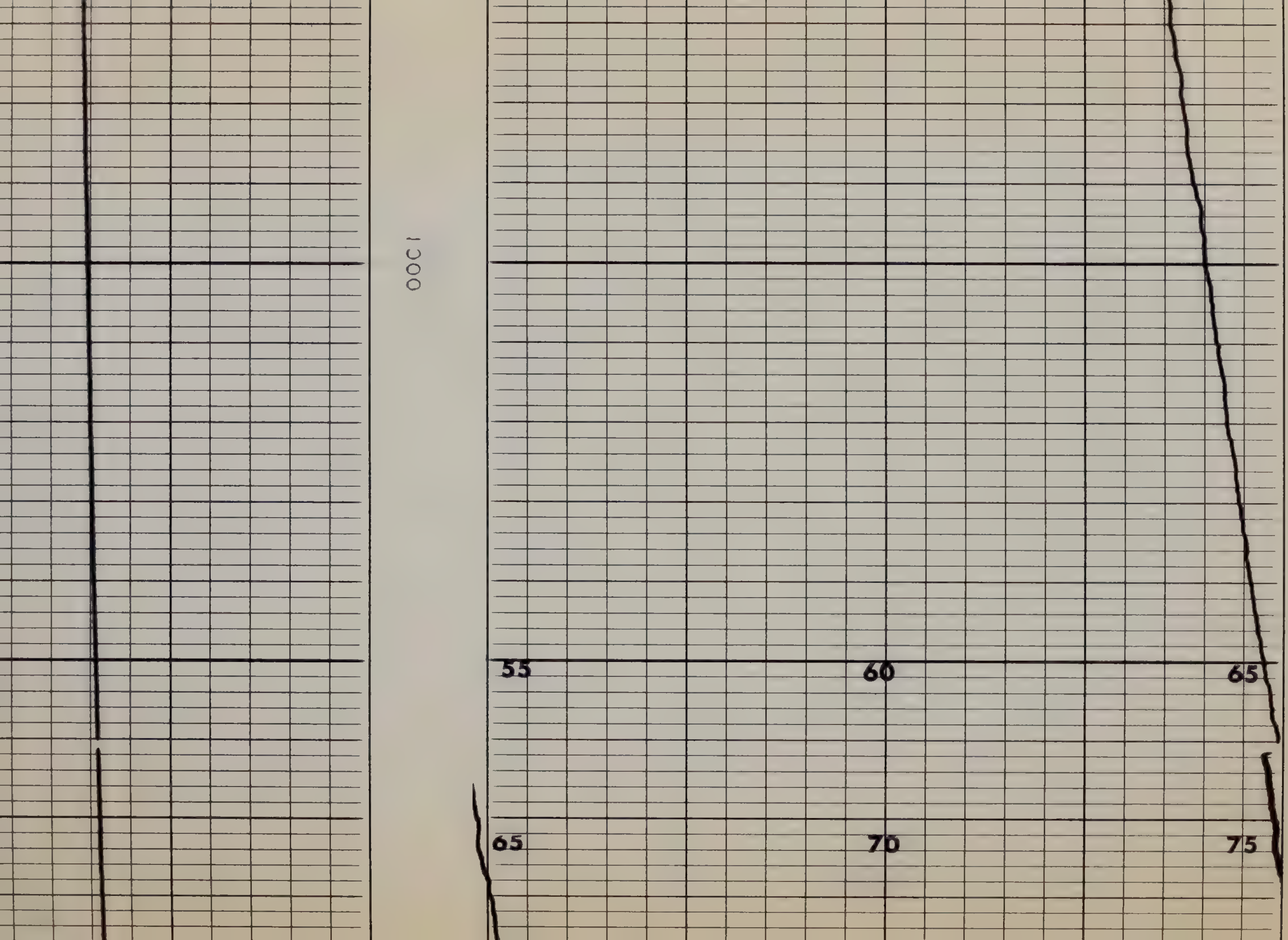
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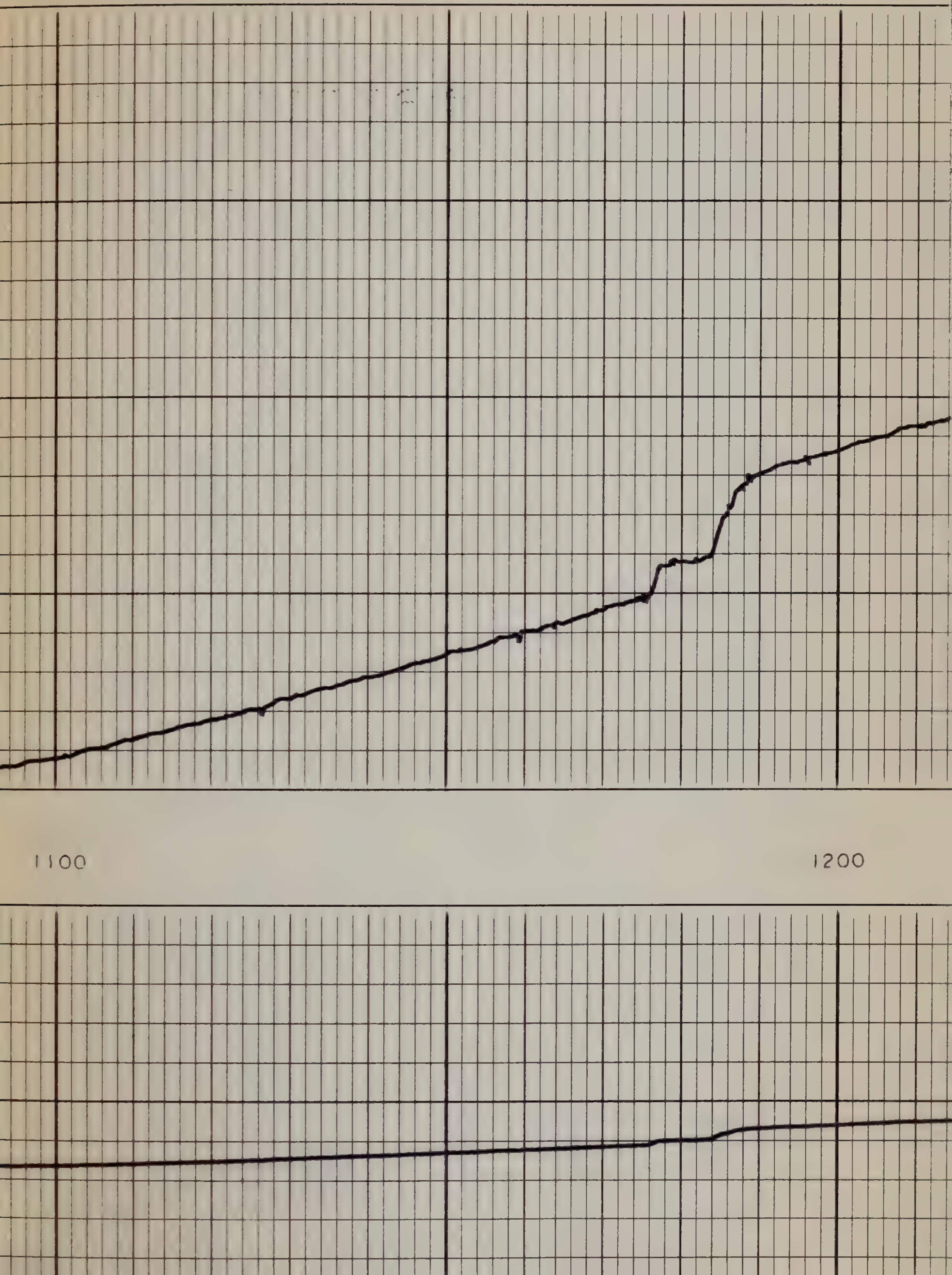
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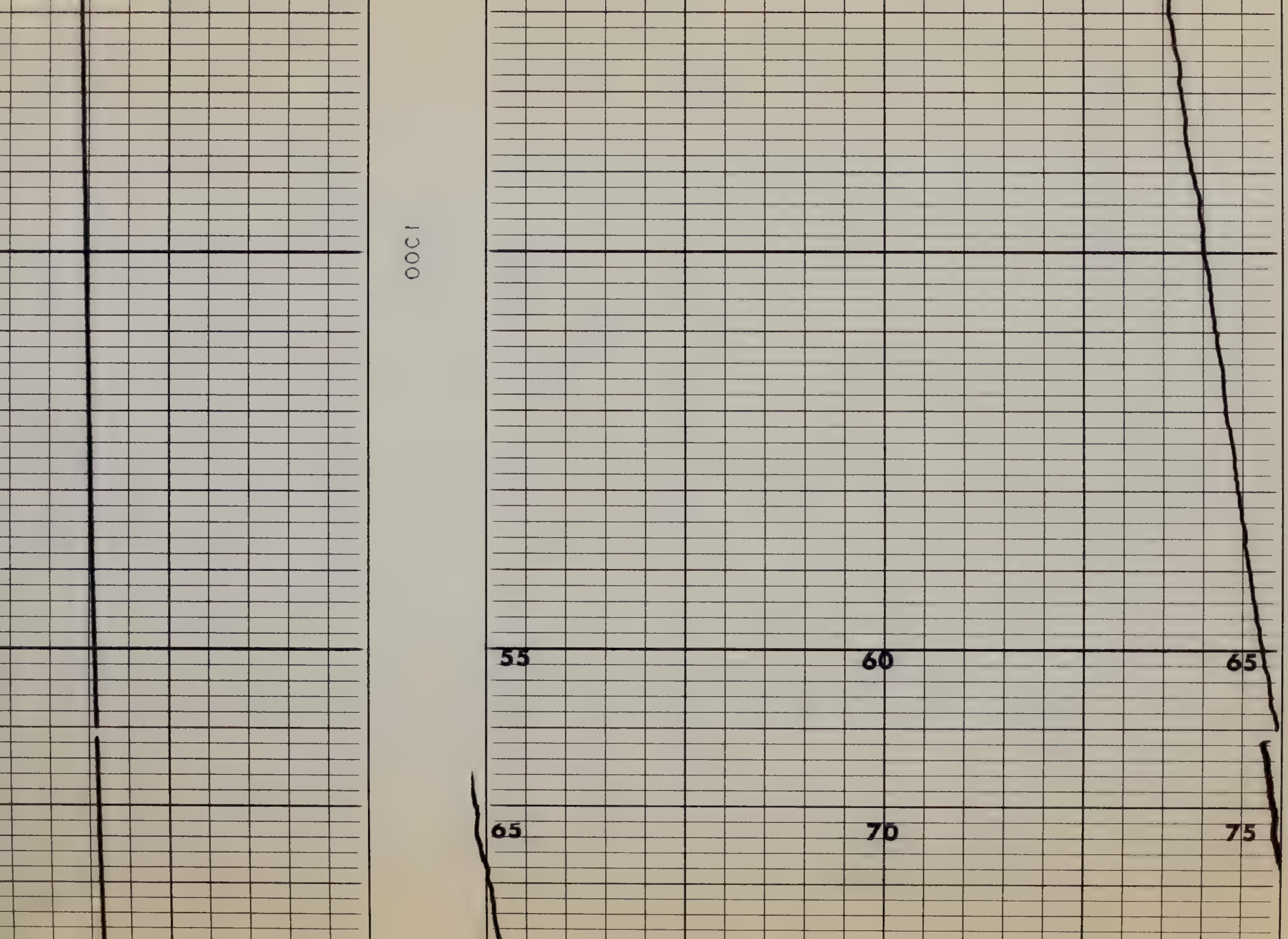
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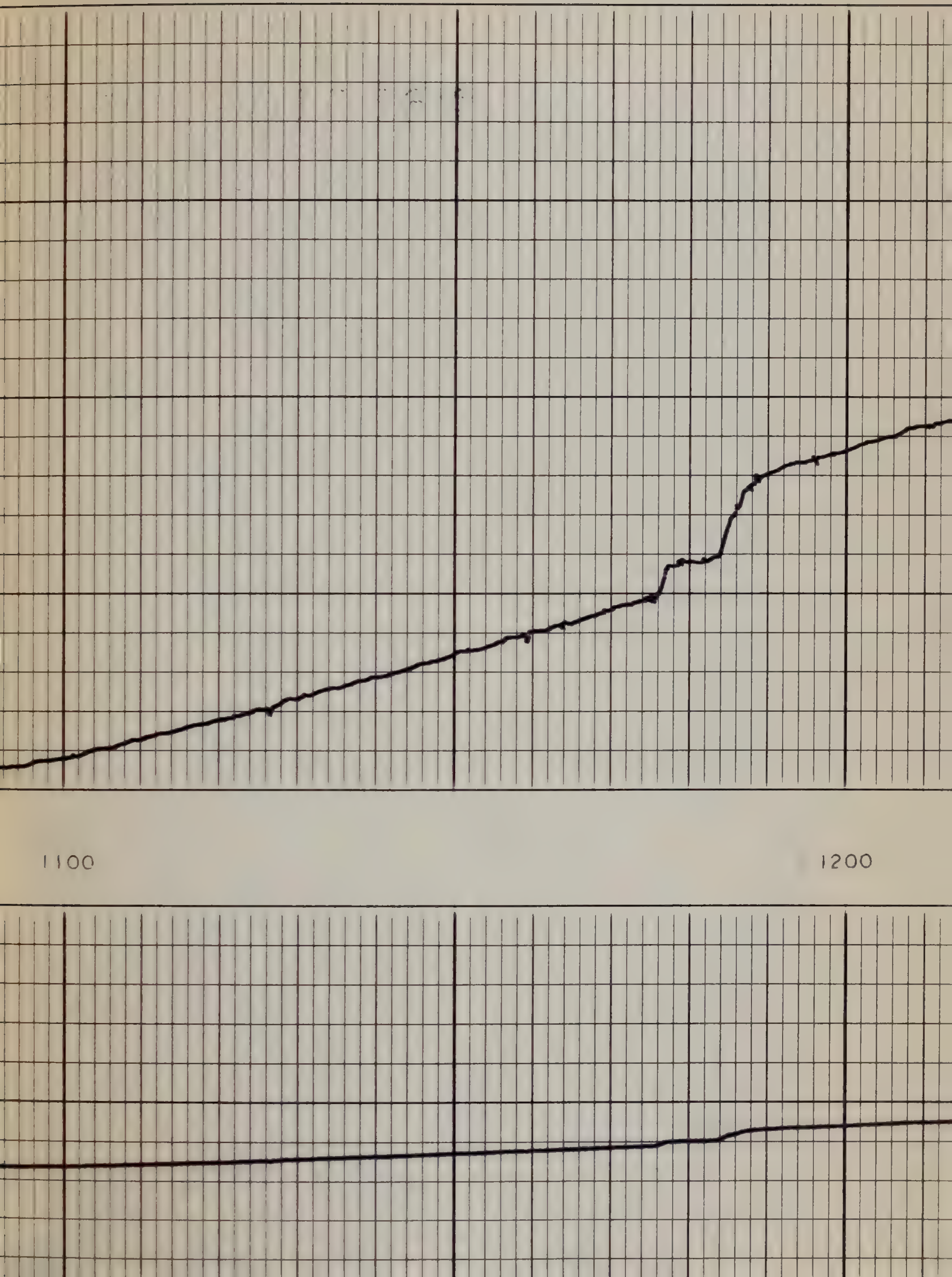
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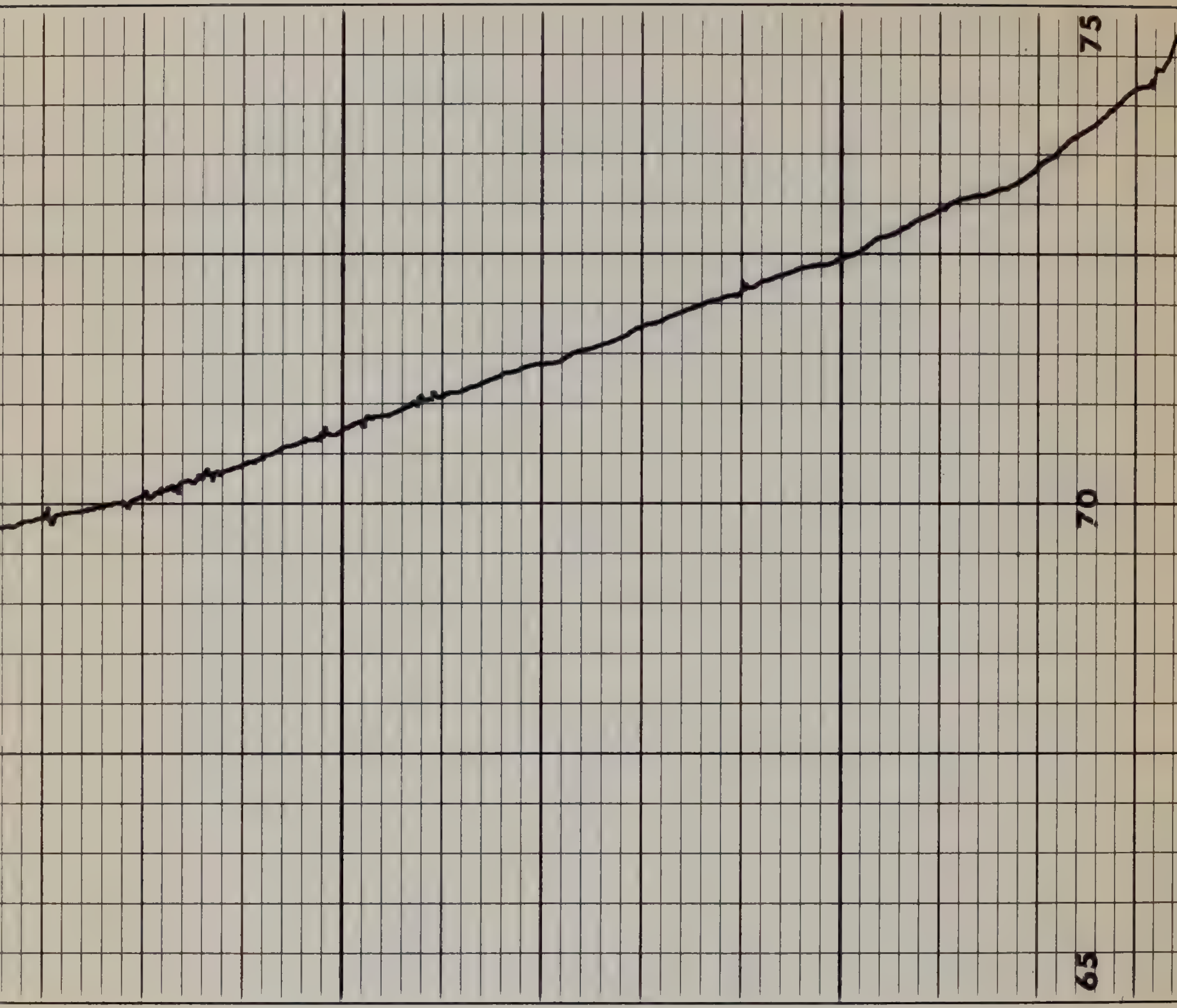

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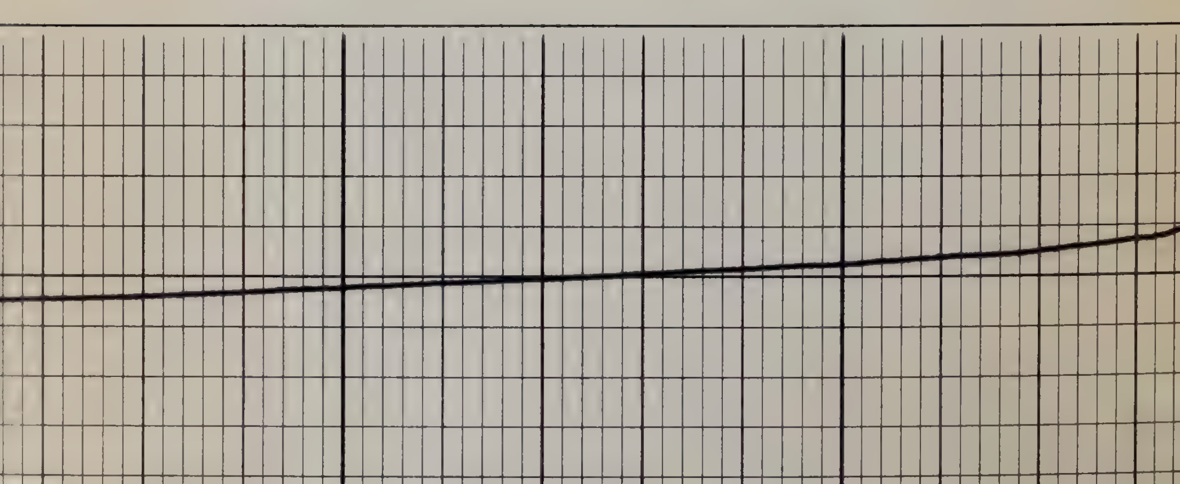

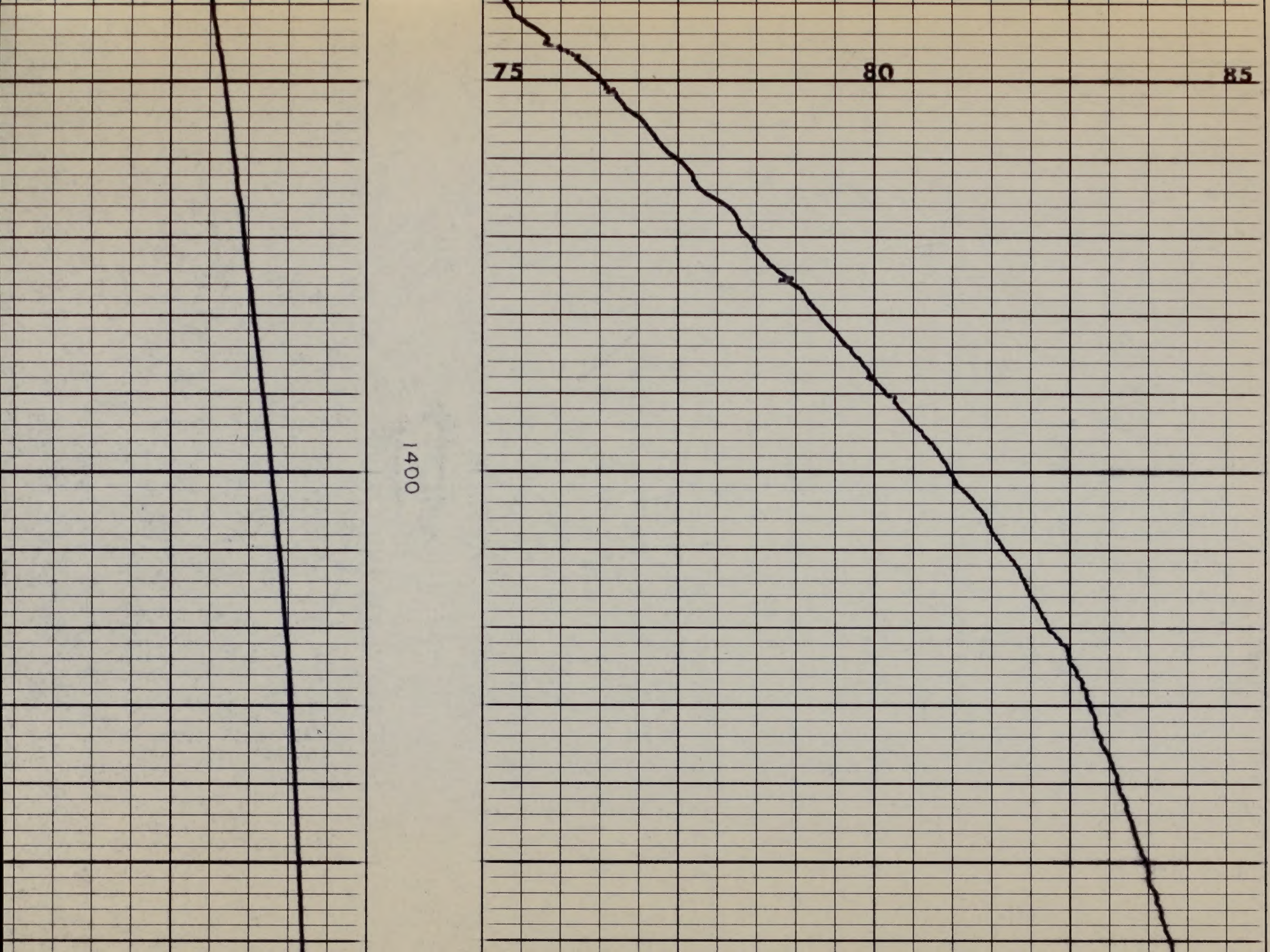
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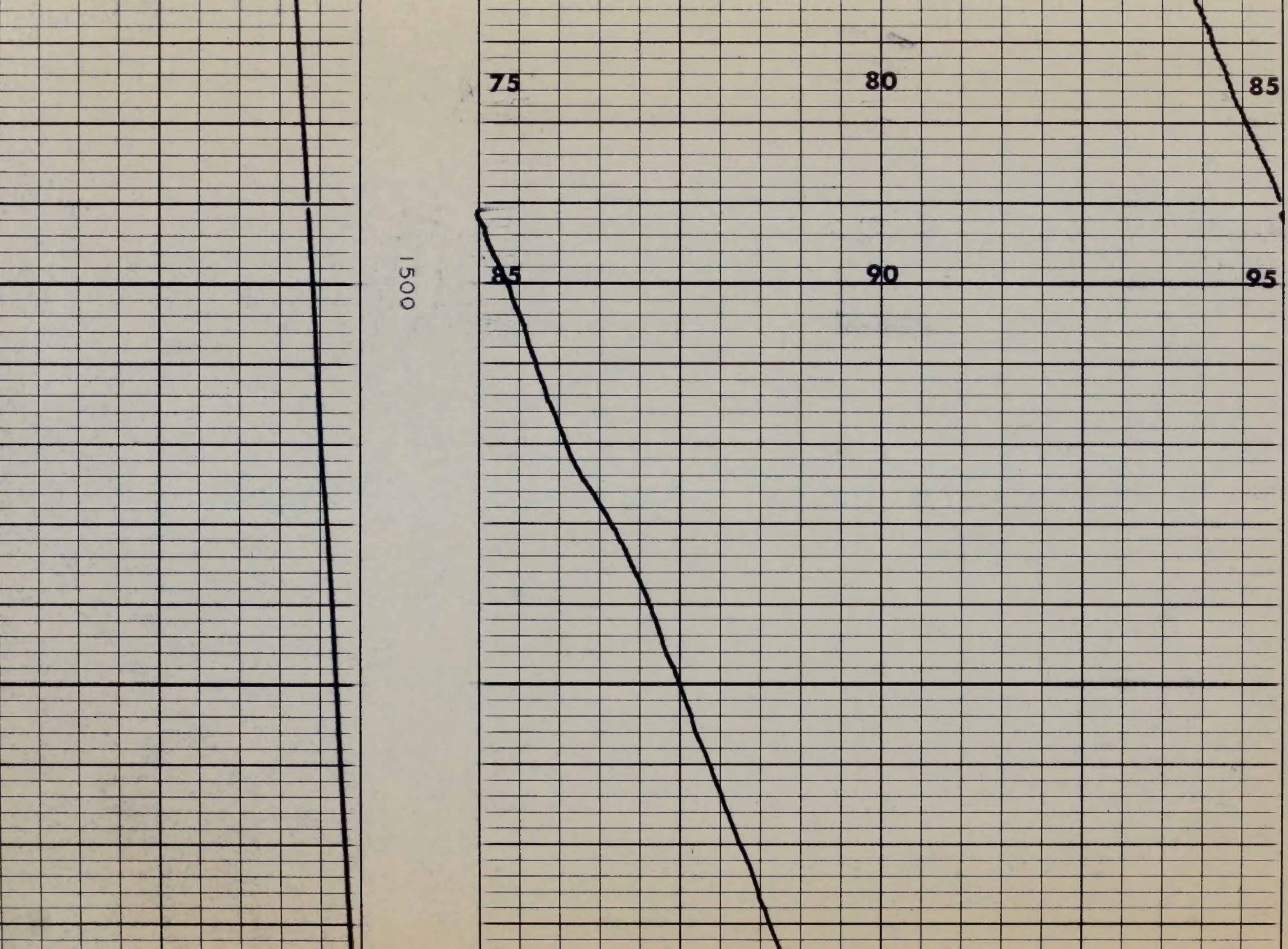
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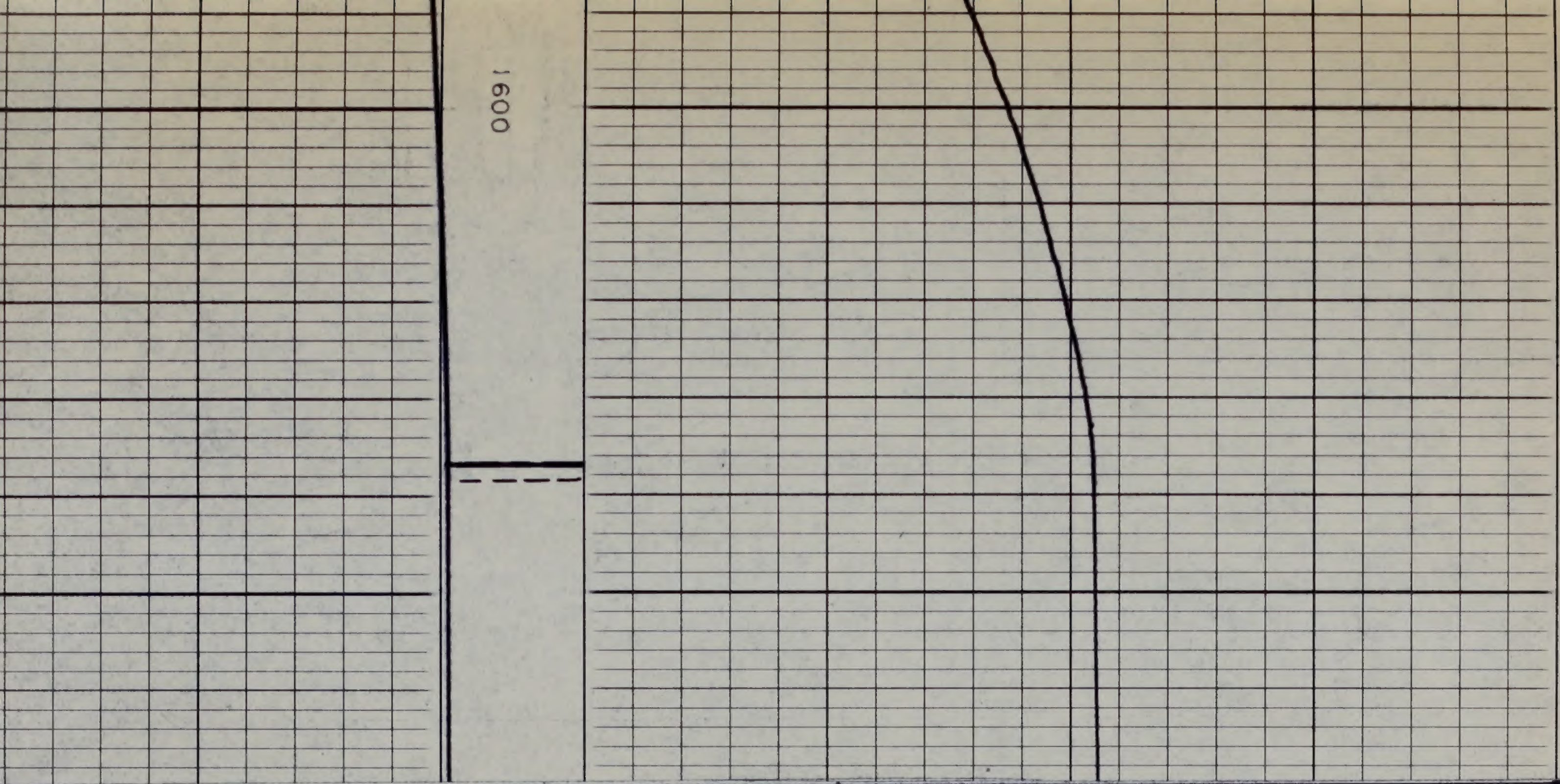

COMPANY THE ATLANTIC RICHFIELD COMPANY

WELL AQUIFER TEST NO. 1-B

FIELD -----

COUNTY RIO BLANCO STATE COLORADO

Elev:
KB ----
DF ----
GL 6909

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